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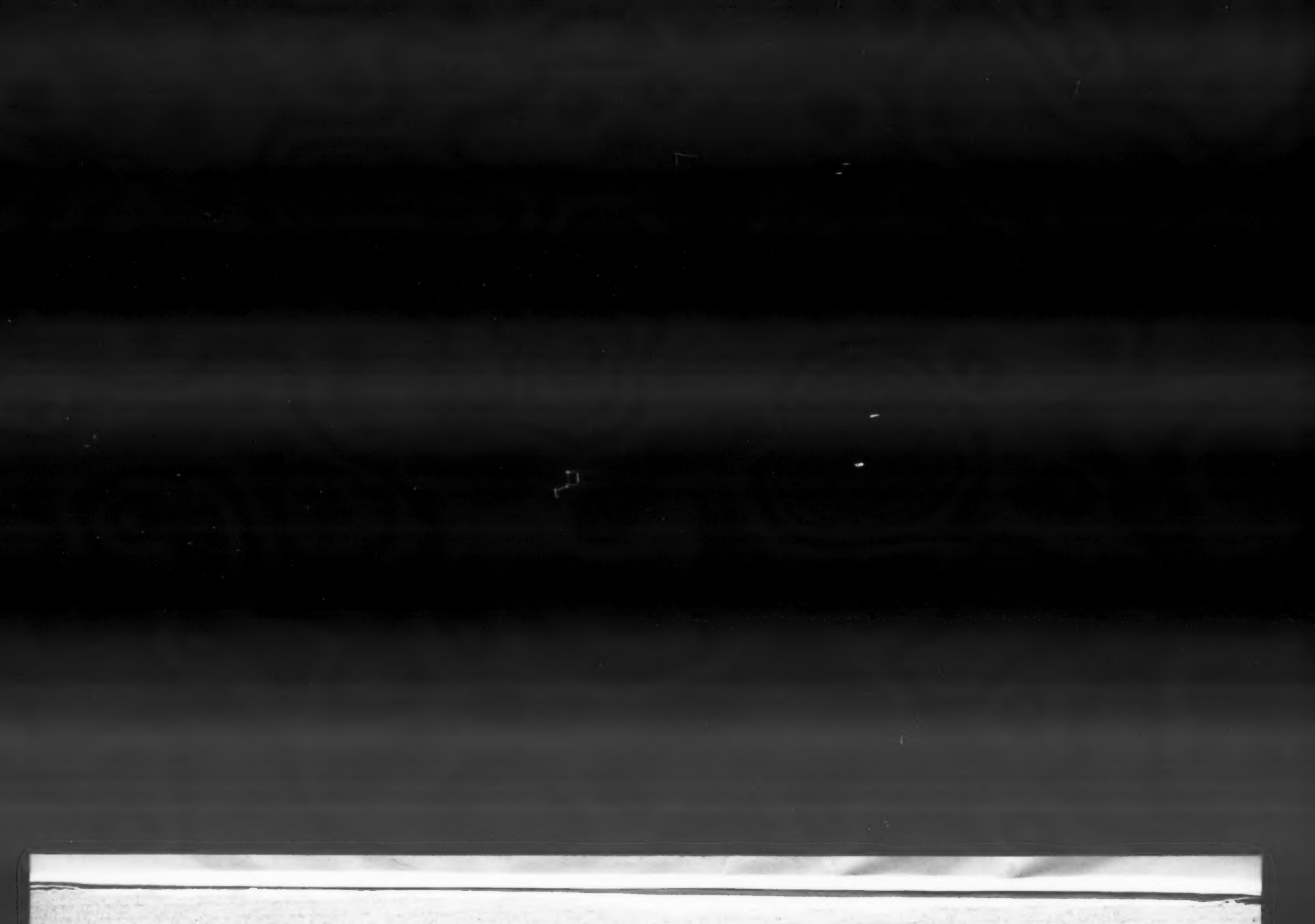


MUNICIPAL ENGINEERING

VOLUME XXX. JANUARY, NINETEEN HUNDRED SIX. NUMBER ONE

FIRE TEST OF REINFORCED CONCRETE.

Following is the report of Chief Engineer Rudolph P. Miller, of the Bureau of Buildings, New York City, upon a recent test of reinforced concrete walls and floors:

On Saturday, November 11th, 1905, an interesting fire test was made under the supervision of this bureau, at Westchester avenue and Port Morris railroad, Borough of The Bronx. The test was made in accordance with the requirements of the New York building code.

The test structure was constructed with 8-inch concrete walls, reinforced by ¼-inch square steel rods, spaced 4 inches apart, both vertically and horizontally. The concrete used for these walls was composed of one part of Portland cement, two parts of sand and five parts of trap rock, averaging about 1 inch in diameter.

The structure itself was 16 feet 8 inches wide and 28 feet 2 inches long, being divided in the center by a 4-inch partition of stone concrete of similar composition to the side walls and reinforced with ⅜-inch rods, 4 inches on centers, placed horizontally and with 3-inch channels of No. 22 gauge sheet steel, set vertically 2 feet on centers.

One chamber of the test structure was covered by a reinforced concrete construction, consisting of two girders 8 inches wide and 15¼ inches deep, reinforced by two ¾-inch square steel bars running near the lower surface, and two ¾-inch steel trussed rods turned up toward the ends, further reinforced by twelve ¼-inch steel stirrups. One of these girders had a clear span of 14 feet, and rested at the ends on 8x8-inch concrete pilasters, reinforced with four ½-inch square steel rods. The other girder was similarly supported, but in addition was also supported at 3 feet from one end by a free standing 10x10-inch concrete column similarly reinforced. The distance between the two girders, which was 6 feet, was spanned by a 4-inch slab of concrete, reinforced by ¼-inch steel bars, spaced 4 inches on centers. The concrete mixture for the girder, column and slab construction was one part of Portland cement, two parts of sand and four parts of ¾-inch trap rock.

The second chamber was covered with a construction of cinder concrete, consisting of one part of Portland cement, two parts of sand and five parts of cinders. This construction was also in the form of two 8x15-inch girders, spaced 4 feet 8 inches on centers, with a clear span of 14 feet between pilasters of similar construction to those already described. Reinforcement in the case of one of these girders was a 4-inch I beam, placed 2 inches above the lower surface of the girder. The reinforcement in the case of the other girder was a 3½x4-inch T beam, also placed 2 inches above the lower surface of the girder. The webs of the I and T beams were punched so as to form 2-inch lips, offering a mechanical bond between the concrete and the steel. The slab between the beams also consisted of cinder concrete, and was 4 inches thick, reinforced with ¼-inch steel bars, spaced 8 inches on centers.

The grate on which the fire was built was 9 feet below the lower side of the slab in each case, and about 3 feet above the ground.

The floor constructions, when tested, were about sixty days old.

A wood fire was maintained in each chamber for four hours, at an average temperature of 1700 degrees F., platinum-rhodium pyrometer couples being used for the reading of the temperatures. During the entire fire test the floors for both chambers were loaded with a uniformly distributed load of 150 pounds per square foot, the constructions in each instance being designed for a working load of that amount.

At the end of the four-hour fire test, a stream of water was applied to the under side of each floor construction for ten minutes, the water being supplied through a 1⅛-inch nozzle at sixty pounds pressure.

On the following Monday, the load on

the floors was increased to 600 pounds per square foot. The condition of the constructions after these tests was as follows:

The walls on the interior were in generally good condition, but it should be stated that no water was directly applied on the walls. The exterior of the walls, due to the differences in expansion in the interior and exterior, were cracked in numerous places. The partition separating the two chambers was bulged about six inches at its center, and had a hole in the top. The stone concrete and cinder concrete floor constructions were affected very much alike, the concrete having spalled off to some extent along the lower sides of the girders, exposing the reinforcing metal for about 60 per cent. of the length of the girders.

The deflections in the several girders were as follows:

The 14-foot stone girder showed a deflection at the end of the fire test of 2 5-16 inches, which increased to 2½ inches after the 600-pound load had been applied; on the removal of that load it returned to 1 15-16 inches.

The short stone concrete girder showed a deflection of 1 7-16 inches after the application of the fire; the permanent deflection, after the removal of the 600-pound load, was only 1 1-16 inches.

The cinder concrete girders showed deflections of 1⅞ inches and 1 7-16 inches after the fire test, which remained practically stationary upon the application of the 600-pound load, and reduced to 1¾ inches and 1 1-16 inches, respectively, after the removal of the load.

PRINCIPLES OF SUCCESS IN CONCRETE BLOCK MANUFACTURE.

By Louis H. Gibson, Architect, Indianapolis, Ind.

The average man can make a first-class cement block if he will. The average worker does not make a first-class cement block, by any means. This is proved by the fact that most architects are afraid of cement in this form. Architects are not afraid of cement in any other form. For many reasons they are distinctly favorable to it in any other forms than blocks. It is just as well for us to acknowledge this fact. The fault is not in the architect. It is in the block, and behind the block is the man. Now, the man can make a first-class block and make money thereby if he will. There is no more convenient form in which to handle concrete as a building material in upper walls than in blocks. This is the reason that the cement block has met with so much of popular favor, notwithstanding the fact that the work of block making has often been done so badly. The builders of houses, the people, recognize the inherent merits of cement and concrete, and because of this fact the cement block idea has met with really more success than its makers deserve. If the cement had had a harder fight for existence it would have been better for the block and eventually better for the pocketbook of the maker of the block and the machine. The past will have to be lived down.

We must make a block of good form with clean, sharp edges, good external texture, interior composition which leaves nothing to be desired, pleasing color, good and varied design. The block must be such an one that the moisture will not penetrate it. The maker of the block must be able to lay out his work from a set of plans and number his blocks to conform to a setting plan, so that they may be taken to the building and placed in position like the stones of Solomon's temple, without the sound of the hammer. The average man can make this kind of block if he will, but the will must be an active all-day, all-the-week and all-the-year will. There is no limit to the stability or structural usefulness of the concrete block. Its form is pliable and its possibilities of beauty are great. There is no color so rich, none so beautiful, none so sedate or dignified that it is not capable of expression and permanent representation in some form of concrete. The view of the future is distinctly encouraging.

We must first learn to make the ordinary cement block and make it well. Now the material so badly composed and badly mixed comes out of the machine with surfaces none too even, edges not clean and sharp and is often badly handled after it leaves the machine. We hear a good deal of talk about the proportion of mixtures; we hear of one to five, and one to four, and one to two, and all that. Some of us fix in our minds certain arbitrary standards. There can be no fixed proportion of cement if one desires to secure a fixed and uniform result in the block. The sand may be ever so sharp and clean, but if it be not properly graded, from the very coars-

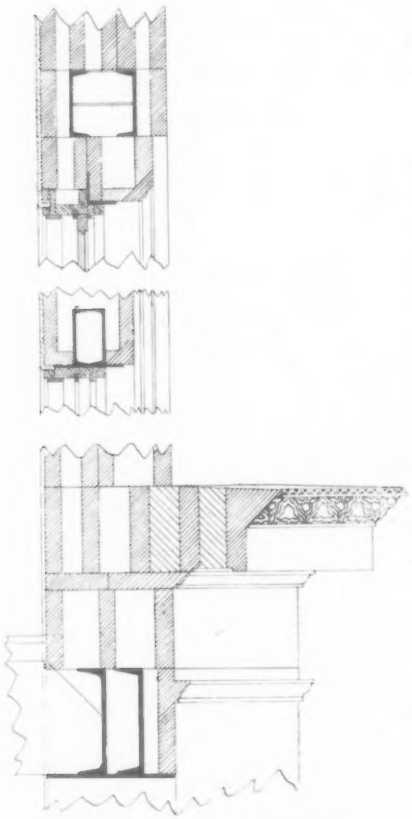
est to the very finest, the proper results will not be secured. The true basis of proportion in the mixture of concrete is in the voids, and the proportion of voids is determined by the proper grading of the sand. The ideal concrete is made when the proportion of voids is reduced to the minimum. This can only be done through the use of the proper amount of fine as well as coarse in the graded sand. In certain communities sand is

CEMENT BLOCK STORE FRONT.

pumped from the river and from pools and pits. In this way it is very easy to grade it either by gravity devices or by sieves, so that there are fine and coarse sand and large and small gravel. The coarser sand, often taken out by screening, presents at first sight a very beautiful appearance. But the trained architect, builder or concrete worker, on closer examination, realizes that he has a very deceitful material and that an undesirably large proportion of cement will be required to make concrete out of this apparently pleasing material. Enough cement would have to be put in to fill the voids left by the fine sand taken out. The ideal block will have the sand, coarse and fine, properly graded, properly mixed and proportioned from the finest to the coarsest, not only on account of the excellence of the block, but as well on account of economy in the use of cement. The aggregate should be mixed dry, preferably by machine, and afterward, in the same manner, with more water than is now used. The success of the bitulithic pavement, which is unquestioned, is largely on account of the grading of its aggregate.

There is too often a sentiment on the part of workmen and manufacturers in a relatively new industry to fight shy of the technical, the scientific and the artistic, and this is particularly true of the manufacture of cement blocks at this time. They have been educated through various sources to believe that the one thing necessary is to make a block, and that the people will buy it, and that they

will make money thereby. In some respects this opinion has been justified in the past. More blocks have been sold than their merit warrants. At present this condition is not so apparent. There is more discrimination, there is more hesitancy and there is more prejudice against the block than there was during its earlier history. The distinguished architects are, almost to a man, against it. However, with the architects this matter is not so serious as with the general public. As



DETAILS OF WALL SECTION.

soon as the properly made block is conspicuously on the market, and as soon as the manufacturer has mastered the structural and artistic difficulties in the way of its production and use, then it will be found that the architect is ready to face about and proclaim to his client and the world that a new architectural medium is at hand and thereby influence the public in the matter. A few carefully designed buildings, carefully executed, will very soon remove all of the prejudice on the part of the people, the architect and the builders which now exists against their use.

It is within the memory of all of us when the brickmakers' work was a small roadside industry. There was the mud pit, the tempering wheel and the mule, the molder who worked at a table, and his off-bearer. There was hard work, a crude product and little profit. Through the aid of the engineer, the architect, the artist and the systematic business man we now have a great manufacturing industry, where the amount of hand labor is reduced to a minimum and where, through the aid of scientific methods, results are exactly and definitely predetermined. We have technical schools devoted to clayworking, and they call to their aid the various branches of science, and the general technical schools are contributing their part to this great industry. The block-making industry must progress along these lines, and while it may appear that there is rather a wide separation between this work, which is so often crudely carried on, and that of the scientist and technical school, yet we have the precept and example of the brick-making industry to guide us. The way from the muddy roadside industry of the clayworker to the technical methods of recent years is much farther than from the cement-block maker's plant of to-day to a condition that the inherent merit of this material justifies. The chemistry of cement is well understood, and certain of the methods of concrete making have been fairly worked out among a limited number of people. But to say that the art of concrete mixing has been fairly well mastered by any large number, or that it is fairly well understood among any large proportion of block makers, would be erroneous. A large part of the trouble on account of absorption is because of lack of knowledge, of practice, on the part of block makers.

It is easy to draw another parallel between the block maker and the brick maker. It was some time after the brick maker was producing a material that was structurally satisfactory before he was able to produce the ornamental brick. This lack was owing to a failure to appreciate the artistic demands of the architect and the public and even at this time the number of manufacturers who are doing worthy artistic work in the production of ornamental brick is very limited. It is a mechanical possibility with all, but very few of them have united the commercial and the artistic sense. Here again, is a lesson for the block maker. He must carry along the idea of beauty and physical excellence in order to achieve the commercial results. If

the manufacturer has not the artistic sense within himself he must have the good judgment to rely upon those who have.

The people were ready to take up the cement block, and did take it up, and had their expectations been met in the quality of the product there would have been a business of enormous proportions to-day. It is the ease with which the sales could be made and the apparent carelessness developed thereby on the part of the makers that has led to much bad work, embarassment and disappointment. An architect whom I know had a client in a county seat who was desirous of adding a porch to a very pretty house that had been built by this architect. The owner wished to use cement blocks. They visited a shed where the blocks were being made, and the architect saw enough to convince him that he did not want a block made in that way. The block maker was not disturbed, because he was working to the limit of his capacity and turning out a very indifferent product, but the owner of the house was anxious. The architect knew that the ultimate result in the porch would not be satisfactory, and in order to prevent their use had to tell the owner that he would have to employ another architect if he wished to use those blocks. In another instance the same architect made plans for a good house in a suburban town. Here the owner wished to use cement blocks for the exposed part of his foundation above the grade. The architect went with him to a shed where blocks were being made, and found the work being done more than ordinarily well.

"Can you have these blocks properly fitted and marked and a setting plan made before they are delivered to the building, so there need be no cutting and fitting or shifting on the work?" was asked.

The makers promised strenuously that this would be done, the plans were left with them and the contract given. In a short time the architect received a long-distance call stating that his plans were wrong. This foundation was of four courses of 9-inch blocks and water table, so there was practically no chance for discrepancy on that account. On the building the architect found a center of interest in a place where there was a projecting chimney breast near a cellar window. Fearing that there might be by chance some error in the figures, the architect ran over the plans while he was standing by the men who were setting the blocks.

"What's the matter?" he asked.

"Why, those plans don't work out," said the setter.

"Do you find anything wrong about the figures?" asked the architect.

"No, not that, but we can't make so many lengths of blocks, and the plans are not practical."

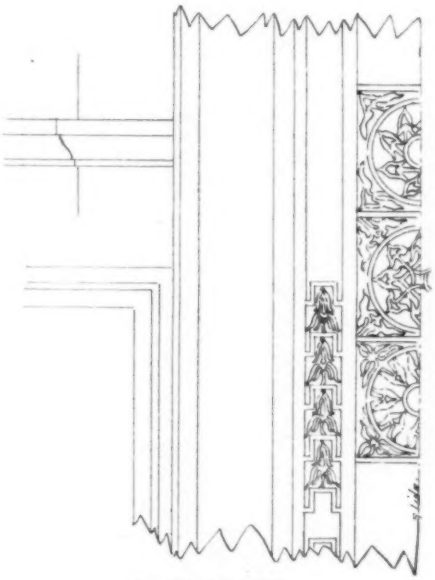
"Is there anything else wrong with the plans?" asked the architect.

"Yes, over on the other side there, that circle bay window will have to be made out of straight blocks."

"Is there anything else?"

"We will have to shift a good many of the windows to work in the right length of block."

"What else?" was asked again.



DETAIL OF PIER.

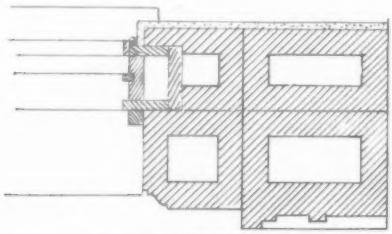
"Oh, if anything else comes up I guess we can take care of it."

These block makers felt very much aggrieved because there was left to them the alternative of throwing up the job or making the blocks to fit the plans.

This story is practically a typical instance in this section. Not all are working in this way, but many are. This architect, as I happen to know, is especially friendly to cement and the cement-block idea. A block that is in every way worthy he is anxious to adopt and use.

Of the two instances above named, one where the block idea was rejected on account of inferior workmanship and the other where it might have been rendered unpopular because of a disregard of the requirements of the drawings, there will

be found many parallels. Improvement must begin with the business methods, continue in the proper composition of the plain blocks and those which have merely structural use, and then the block maker



PIER SECTION.

must be able to make certain pleasing and ornamental forms. He must not merely say, "I will make what you want," but he must be able to say, "Here is something which will please you." Some of the makers of ornamental brick are able to do this now and are prospering because they have certain well-made standard architectural forms which a self-respecting architect is not ashamed to use for moderate-cost work. Then the maker of the block must be able to lay out a shop drawing and letter and number his blocks and pieces so that the exact location of each is indicated. Even here his responsibility does not end. He should see to it that they are properly placed and the work properly pointed and cleaned. The block maker must not expect a sympathetic hand or touch from the bricklayer, the stone cutter or setter. It is to the interest of the block maker and the block business that he see his material set properly in position in the finished building. It is upon the reputation of the block thus established that the business life and welfare of the block manufacturer and the machine manufacturer must rest. Atfer all, it is a question of the block in the wall as to whether the owner is pleasd with it and as to whether the public is pleased. Public opinion is built upon the performances of the past, and not upon hopes as to the future.

Far be it from the writer to utter one discouraging word in connection with this great industry. All that is said is said in a spirit of helpfulness. If he did not know that satisfactory blocks were being made, and did not believe that many more will be made there would be no effort on his part either to criticise or to foster this industry. It is only criticised because of the realization of the great and prosperous future which is before it. The average man can make the good block and he can get it into the building in a satisfactory way if he will.

The design which is here given is of a small store front. It may be erected in brick, which is a burned-clay block. It may be erected in terra cotta, which is another form of burned-clay block. It may be erected with blocks of stone. As herein detailed and as conceived it may be executed quite as well in cement blocks. From the standpoint of design and execution terra cotta, brick and cement blocks are closely allied. Nearly all the forms of terra cotta construction are so made that they can be molded in flasks in practically the same manner as cement blocks, excepting that terra cotta work is nearly all done by hand and the cement block work is practically all done by machinery. The photograph of the decorative forms of this design is taken from the plaster casts, and, being of plaster drawn from the molds, is clear enough evidence that they could be executed and cast in concrete. As to whether they can be cast by machinery or not is purely a matter of business. If it pays to cast them by machinery, all well and good. If

DETAILS OF ORNAMENT.

not, cast them in forms by hand. It is a mechanical possibility to cast them by machinery in the same way that other cement blocks are made. The pilasters of the size shown are of the blocks indi-

cated in the photographs. If desirable for business reasons they could be jointed differently. This would be largely a question of shop practice. No two terra-cotta factories would adopt exactly the same plan of jointing on the same job. The way this sort of thing is ordinarily done it to take the architect's plans and details and make a shop plan indicating jointings and certain structural details. This is submitted to the architect for approval and suggestion, and as a result of conference it sometimes happens that changes are made to the mutual satisfaction of both parties. Terra-cotta workers are especially skillful, unusually competent and full of resource in matters of this kind, and the competent and experienced architect is always glad to avail himself of the suggestions of these specialists so long as they in no way suggest changes or undertake in any way to interfere with dimensions, forms or the artistic elements of the design. The terra-cotta establishment is thus referred to because in shop methods, and especially those which relate to the laying out of the work from the drawings, it is closely allied to the necessities of cement-block making. The block maker can learn a great deal from a terra-cotta factory. There is no class of men in the building business who are more systematic, thorough or who have more fully mastered the technicalities of their business than the terra-cotta superintendents. The block maker, however small his business, will find it to his interest to systematize his work along the general lines of the terra-cotta factory. It predetermines accurately all costs and anticipates all structural contingencies. It locates definitely all lines of responsibility as they affect the interests of the architect and the various sub-contractors who in any way have relation to his work.

The cornice of this building can be made of cement tiles. The supporting members are of light metal framework. The opening over the store front and those over the windows are structurally carried by steel members. The larger openings are covered with channels and the smaller ones with angles. The determination of their sizes is a very simple matter in engineering requiring only a calculation of the weight of the structural material, which represents the dead load, and an allowance for whatever live load there may be superimposed. There is no part of the work of using cement blocks structurally which has brought the business generally into greater disrepute than the clumsy methods which have been frequently employed about door and window openings. More cement-block buildings have been botched at this point than by any other structural errors. The jointing of this design is a very simple matter and could be subject to some latitude without in any way affecting the integrity of the design. No pitched faced blocks are used in any part of this work.

STREETS OF WILMINGTON, DEL.

Wilmington, Delaware, is a city of 80,000 population, with an area of 1,018 square miles, having 93.3 miles of streets and 45.2 miles of stret railways owned by two companies. The city seems to have begun its paving about 1887, but 16,595 square yards of granite block pavement having been laid prior to that year. Some granite block pavements were laid each year until 1892, the amounts varying from 1,700 to 14,000 square yards a year, with occasionally a few yards of asphalt block and brick pavements. In 1892, the city entered upon the work of paving in earnest, and in that one year laid 46,088 square yards of granite block, 230 square yards of asphalt block, 38,601 square yards of vitrified brick and 9,652 square yards of rubble stone. This speed was kept up for about seven years, including the year 1898, when the rate of construction of pavements dropped to two or three thousand square yards a year of granite block and four to eleven thousand square yards of brick, the asphalt block and rubble stone dropping out, except for a year or two occasionally. The result is 37.2 miles in all, of the more permanent pavements named. The absence of sheet asphalt is notable. In 1904, 472 square yards of bituminous macadam were laid on Thirteenth street, between Market and King, and the first of the accompanying photographs shows this block, the granite block pavement of Market street showing in the foreground.

The city has 18.9 miles of macadam and telford pavements, all of these pavements having been laid since 1890, and over 80 per cent. of them in the seven years of active paving work. Three of the accompanying photographs show the character of these pavements and the condition in which they are kept.

During 1904 the granite block pavements laid cost from $1.80 to $2.29 a

square yard, the vitrified brick pavements $1.16½ to $1.75, the bituminous macadam $2.62 and the ordinary macadam 84.3 cents to 92.6 cents a square yard. In the report for that year the cost of brick paving is fully itemized, and the figures are as follows, per square yard:

Grading, $0.325 to $0.385.
Foundation, $0.054 to $0.133.
Bricks, delivered, $1.04.
Laying bricks, $0.06 to $0.09.

Total cost of pavement, including also sand and rolling, $1.61 to $1.735.

Total cost, including also resetting curb, fixing sidewalks, tools, etc., on two of the four streets laid, $1.615 to $1.75.

Average total cost of all brick pavements laid in 1904, $1.71.

We are indebted to Secretary L. V. Christy, of the street and sewer department, for the photographs accompanying this article.

HAIR CRACKS, CRAZING OR MAP CRACKS ON CONCRETE SURFACES.

By Albert Moyer, New York City.

The appearance of hair cracks on a concrete surface is a disfigurement the cause and remedy for which have not received the proper study that so important a subject justifies. The cause of this trouble has been investigated from time to time, but heretofore the conclusions drawn have been very incomplete.

Hair cracks, being entirely on the surface, do not indicate a weakness in the concrete; in most instances they are not greater in depth or width than that of a coarse hair. A rough-surface concrete does not display these objectionable features to as great an extent as does an even-troweled face, on which surface they are very apparent, especially in damp or wet weather. Often these cracks do not appear for several weeks or months after the concrete has set hard.

A practical worker in concrete is not as much concerned with the cause of hair cracks and crazing as he is interested in their effect and remedy. It often requires investigation as to cause to arrive at a correct solution of the trouble and thus apply permanent remedy; otherwise we would be simply dealing with symptoms.

Research conducted along theoretical lines seldom brings practical results; therefore the writer will endeavor to eliminate theory as fast as possible. My investigation has been founded on the reverse practice—that of noting and observing very carefully the practical results both as to effect and remedy and then endeavoring to explain these conclusions by theory.

It has been known for some time that very wet concrete is more apt to craze and show these undesirable hair cracks than dry concrete. Dry concrete is objectionable from the standpoint of strength and density, and therefore its use cannot be advocated simply because hair cracks are to some extent avoided. Investigation and practical demonstration leave no doubt of the fact that in wet concrete a portion of the flour or very finest particles of the cement is carried to the surface by the action of the excess water which is being absorbed by the atmosphere. This excess water is to a great extent drawn from the interior of the stone to the exterior, carrying with it the finer particles, which, being deposited on the surface, form a richer mortar than is contained in the body of the concrete. Under certain conditions there fine particles deposited on the surface practically form a coating of neat cement.

Neat cement or the richer mortars are found to be much more liable to crazing than mortars containing a larger proportion of sand or finely crushed stone. This is particularly true in the manufacture of cement stone by the use of sand molds into which the mixture is poured very wet. It has also been noted that when the stone is properly seasoned by keeping the surface covered with a thick layer of very wet sand, or when the stone is immersed entirely and for some time in water the trouble has been overcome almost entirely. These hair or map cracks would be entirely eliminated for all time if the stone were immersed in water for a sufficient period to allow the complete crystallization of the cement. This, however, is not always permitted by convenience or economy.

The crazing of neat cement is apparent in test pats for laboratory purposes when these pats are exposed and allowed to set and harden in air. But if they are protected in a moist closet and afterward immersed in water for a period of at least twenty-eight days no hair cracks or crazing will result.

A careful examination of these cracks leads to the conclusion that they are due entirely to a contraction of the surface, the same contraction not taking place in the body of the concrete.

Experiments made by Prof. Swain and

I. THIRTEENTH STREET, WILMINGTON, DEL.
Bituminous Macadam.

Prof. Bauschinger demonstrate that neat cement, when set and hardened in air, contracts. This applies to all brands of high-grade Portland cement. Further tests demonstrate that this contraction increases with age up to a certain period. The same authorities demonstrate that a mortar made of one part Portland cement and three parts sand, hardened in air, shows contraction, but less in proportion than the neat cement. It is obvious that this bears out the practical investigations regarding concrete and cement stone which have been described above—that is, hair cracks are due to contraction of the surface, and that this contraction is due to the fact that the concrete has been hardened in air.

I will now describe the results obtained by investigations made by the same authorities and others showing the effects of neat cement and mortar when hardened under water. The test pats or cubes of neat cement and mortar after the final set were immersed and kept under water for a considerable period of time. The results prove that neat cement, when hardened under water, shows a slight expansion, while mortar composed of one part Portland cement and three parts sand shows an expansion, but less in proportion than the neat cement.

Reducing these conclusions to figures and taking the average results obtained by various authorities, figuring the expansion and contraction in percentage, I find the following results:

Neat Portland cement hardened in air, at the end of sixteen weeks, shows 0.15 per cent. contraction.

One-to-three mortar hardened in air, at the end of sixteen weeks shows 0.05 per cent. contraction.

Neat Portland cement hardened under water, at the end of sixteen weeks shows an expansion of 0.05 per cent.

One-to-three mortar hardened under water, at the end of sixteen weeks shows an expansion of 0.15 per cent.

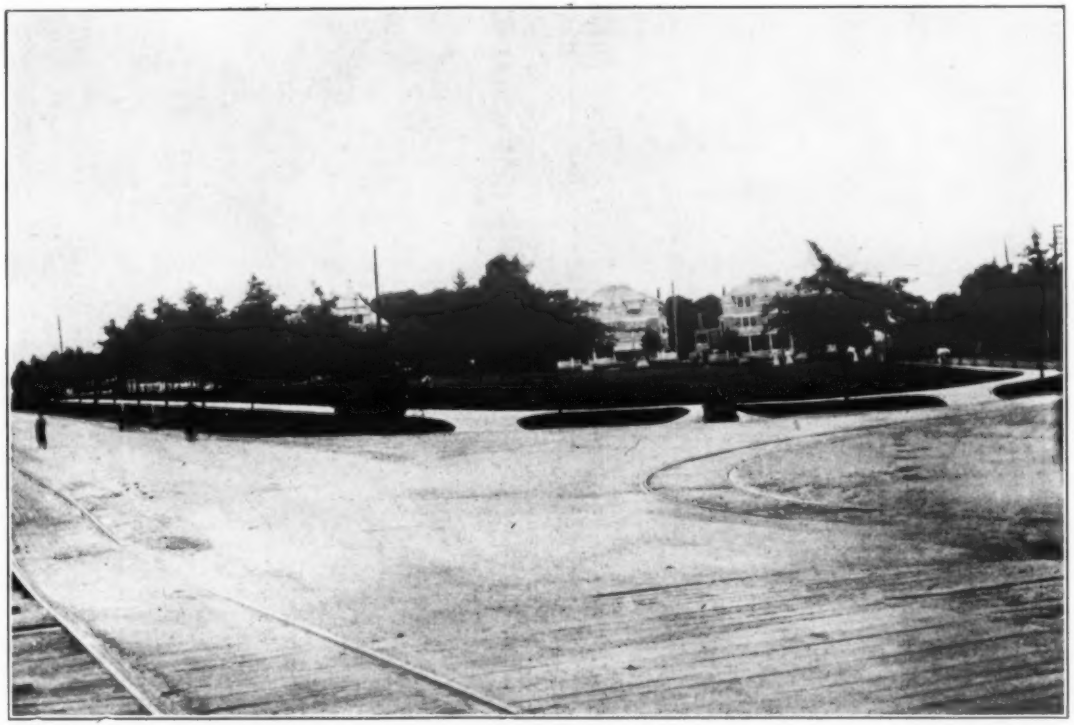
Without going further into the matter of figures, it is safe to state that the expansion and contraction is less for shorter periods than sixteen weeks, and that the percentage will be a trifle greater if carried up to six months or a year.

We can therefore conclude that in a rich mortar there is more neat Portland cement on the surface and therefore a greater percentage of contraction of the surface; also that a less rich mortar will show a proportionately less percentage of contraction, and that if the concrete were kept wet and protected (which is equivalent to hardening under water) hair cracks and crazing would be avoided.

In the past this trouble has been partially overcome by brushing off the surface of the concrete or cement stone with a stiff steel brush or by scrubbing the surface with a cement brick and wet sand, thus partially removing what might be termed a neat cement face. It has been found, however, that this does not entirely overcome the trouble, the remedy proving but temporary, the cracks appearing several months afterward. The brushing or scrubbing is merely an assistance; the real remedy lies in keeping the surface thoroughly and continuously wet as long as possible. It is unfortunate that this rule is seldom observed, and that in its non-observance good results are sometimes obtained. The worker in cement is thus influenced to disregard a matter of considerable importance in concrete construction. That good results are obtained from a disregard of these principles is largely a matter of luck. If the weather be damp for a number of days after the concrete has set the object has been partially brought about by nature; then, again, the surface may have been so placed as to escape exposure to the wind or sun, which would tend to dry it, and was kept wet by the excess of water in the concrete. It is desirable to have the surface of the concrete or cement stone near the same texture as the body of the concrete.

The only permanent remedy which will eliminate entirely these objectionable features is the removal of as much of this excess of neat cement collected on the surface as is possible, as soon as the molds are taken down. The surface should then be kept wet by the application of wet sand, sprinkled from time to time with water or hanging wet cloths over the perpendicular surfaces, keeping the exterior wet and the cloths wet by sprinkling or by any other method which will accomplish this result. The surface should be kept continuously wet for a sufficient length of time to enable the cement to attain ultimate crystallization. By so doing the effect is practically the same as that of hardening under water. It is reasonable to conclude that if so treated the surface will slightly expand, but not to a greater extent than the body of the concrete, which is already wet.

It is not amiss to bring this whole subject as prominently as possible before those having charge of concrete construction, endeavoring to impress upon them the necessity of keeping concrete protected and thoroughly and continuously wet for as long a period as economy will permit.



II. BOULEVARD AND WASHINGTON STREET, WILMINGTON, DEL.
Macadam.

EDITORIAL COMMENT

Liabilities of Cities.
Preservation of Niagara.

LIABILITIES OF CITIES.

A recent issue of the monthly bulletin of the statistics department of Boston, Mass., contains an interesting study of the liabilities of cities in that State and the objects for which they are incurred. There are tables showing the details in the various cities and towns, in districts about Boston, Fall River, Lowell, Springfield and Worcester, detached cities and in towns of over 10,000 inhabitants. These are collected in a table of summaries, and the percentages of the liabilities for various objects to the total liabilities are derived in a co-ordinate table. The variations in these percentages are interesting if somewhat incomprehensible without a knowledge of the histories of the cities and towns.

The objects for which liabilities are incurred are classed under highways and bridges, public buildings, parks, waterworks, sewers and miscellaneous objects.

All grades of municipalities have about the same relative desire for public buildings. The average ratio which the liabilities for public buildings bears to the total liabilities is 16.32 for the state, 10.41 being for school houses and 5.91 for other public buildings. Towns have a percentage of 16.69 in districts near cities 18.41 if over 10,000 population and 12.63 if less, with 56 having no liabilities. Cities have an average percentage of 16.47, of which 10.23 is for schools. This equality of percentages is carried through the details of the tables, the minimum being the 12.63 for towns less than 10,000 population and the maximum, 17.94, for towns in the metropolitan district, Boston itself having 17.63 per cent., with 10.06 per cent. for school houses.

Strangely enough, the percentages for miscellaneous liabilities vary but little also, the average for the State being 20.53 per cent. of the total liabilities, towns in the metropolitan district having the minimum of 15 per cent., towns under 10,000 population having the maximum of 33.76 per cent. and Boston having 17.48 per cent.

The percentage of liabilities for waterworks to total liabilities varies from 9.34 for Boston to 52.52 for towns of over 10,000 inhabitants, the average for the State being 24.15. Water is evidently a more expensive commodity for the towns, the percentage for towns outside the influence of cities being 44.10 as against 21.72 for cities and 9.34 for Boston. This is partly on account of greater cost per capita and partly on account of more general investment of towns in waterworks than in parks, sewers, highways and bridges, so that while the actual investments in waterworks may not be excessive per capita, the percentage to total liabilities is larger.

This is shown by the figures for sewers where the minimum is 6.99 for towns under 10,000 population and the maximum is 17.50 for towns in the metropolitan district, Boston being 9.90 and the entire State 12.60 per cent. The effect of the metropolitan water and sewer districts upon the cities and towns surrounding Boston and included in the metropolitan district is shown by the maximum of 17.50 in the towns and 12.27 in the cities in that district as compared with Boston's 9.90 per cent. in the case of sewers and 32.85, 15.63 and 9.34 for the same groups in the case of waterworks. These cities and towns have many of them been obliged to construct sewerage and sewage disposal systems for the benefit of the metropolitan water supply which would otherwise have constructed comparatively inpensive systems, and the results show in increased percentages of liabilities for this class of improvements.

The figures for highways and bridges show that the cities make comparatively large expenditures for these improvements, Boston having a percentage of 26.94, cities in the metropolitan district outside of Boston one of 23, all cities an average of 18.04, towns in metropolitan districts an average of 7.12, outlying towns of over 10,000 population 0.73, all towns 5.14 and the State at large an average of 16.32. The necessities of the cities in expensive pavements are here clearly shown.

The expenditures for parks show similar variation, Boston having 18.71 per cent., cities in the metropolitan district 15.16 per cent., all cities 11.15 per cent, all towns 3.17 per cent., rural towns of 10,000 population or more 0.05 per cent. and the State at large an average of 10.09 per cent.

The per cent. of net debt to valuation

III. GILPIN AVENUE, WILMINGTON, DEL.
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runs from 4.87 for all cities and 4.64 for Boston to 2.53 for rural towns of less than 10,000 population, the average for the State being 4.36.

Tax rates vary only from $15.55 in towns having liabilities to $16.52 in cities generally, Boston having only $15.20. Towns without liabilities have tax rates of only $11.92, those with liabilities having nearly $4 higher rate.

The final table in the series shows that the cities carry 83.92 per cent. of the total municipal indebtedness of the State, the percentages for various objects varying from 77.98 for waterworks to 95.8 for highways and the same for parks. Towns carry 16.08 per cent. of these debts, the percentages for various objects running from 4.2 for highways and for parks to 22.02 for waterworks, the total for the State being 100 in each case. This again shows the comparatively large indebtedness of towns for waterworks, and the comparatively low expenditures for parks and highways. The dominating position of Boston in the State is shown by the fact that it carries 40.48 per cent. of the total net municipal debt of the State. Its large expenditures for parks show in the 81.25 percentage of the State's debt for them which it carries. For highways its debt is 72.69 per cent. of the total for the State, while for waterworks it is only 17.04 per cent. and for sewers 34.59 per cent. Possibly the indebtedness of the metropolitan sewer and water districts is not included, this being an obligation of a separate corporation made up of many cities and towns. The table is silent upon this point.

PRESERVATION OF NIAGARA.

The American Civic Association has taken up the question of the preservation of Niagara in earnest, and shows conclusively the necessity of taking the necessary preliminary steps at once. We have perhaps been blinded to the destruction of a natural wonder by the building up of artificial wonders which like all artificial monsters are shortly overshadowed by greater creations of the human mind. The failure of the power companies to pay tribute in any way to any one for the vast natural resources with which they have been presented and their further failure to benefit any one by furnishing power at less rates than it could be supplied for by other means are fully shown in the following from one of the Association's leaflets:

Ten power-developing companies (four American and six Canadian) now have authority to utilize 35¼ per cent. (1,339,500 horse-power) of the effective power of the falls. These developments, if fully utilized, will, in the judgment of engineers, destroy the American fall, for the reason that but 12 per cent. of the average flow of Niagara passes over the 1,060 feet of the American fall.

If even half the authorized amount of water is withdrawn above the cataract, the American rapids will be entirely bare of water except for a thin trickle to pass over the face of the American fall.

Five companies are now exercising their franchises and actually developing power, while the others are actively preparing to do the same.

The power development so far has not resulted in any general benefit to the people at large. The city of Buffalo is lighted by Niagara-made power, for which it pays $75 per 2,000 candle-power arc light per year, a sum considerably above the average price paid by American cities for the same light produced by means of burning coal. Trolley fare in Buffalo, the trolleys being driven by Niagara power, is five cents, and the trolley companies pay no more taxes and no greater proportion of gross revenue to the city of Buffalo than the average American cities where coal-produced electricity is utilized.

If half the authorized power is developed by the companies now having permission, and if half this power is sold at half the price now being charged, an income of approximately twenty millions of dollars will be received by the ten companies involved, of which not one cent would go to the State of New York, while the Dominion of Canada would receive approximately only $240,000 per year. As it is estimated that there are less than one thousand stockholders in the ten companies involved, the benefits conferred are obviously confined to a very few persons.

The preservation of Niagara falls can be accomplished only by the combined action of the American and Canadian governments. President Roosevelt made to Congress a strong recommendation in his annual message, and has urged, both in the interview above mentioned and in letters, that facts, such as are above submitted, should be presented in connection with remonstrances to the Congressmen, so that they may act promptly and decisively for the saving of Niagara.

According to Charles M. Dow, president of the board of commissioners of the New York State reservation at Niagara, the treaty of Ghent, which fixed the boundary lines in the Niagara river, "devolves upon the two governments the moral duty of protecting it." The State of New York has invested in the reservation at Niagara falls about $2,500,000. Quoting Mr. Dow, "Whatever impairs the value of Niagara falls as a spectacle impairs the value of that investment."

The ordinance of 1787 recognizes the common interest of all the States and Territories in the Niagara river, for it recites that all waters flowing into the Mississippi and the St. Lawrence rivers and the carrying places between shall be held as public highways forever free to the people without impost of duty.

It is understood that the proposition to take international action upon the matter will be presented to Congress this session, and all those who are interested in the least in preserving one of America's greatest natural wonders should write promptly to their Congressmen, impressing upon them the need for favorable and prompt action.

IV. NINTH STREET, WILMINGTON, DEL.
Macadam.

THE QUESTION DEPARTMENT

BOOK OF INSTRUCTIONS TO CEMENT WORKERS.

I find Brown s "Handbook for Cement Users" a very useful work, but want to ask if there is not something published that gives more of the common details in the uses of cement. For instance, I am interested in building some door steps for myself, but don't know how to make patterns or forms for same. The contribution to your magazine by R. B. Clement, and quoted on page 256 in the handbook, while complete doubtless to a mechanic, leaves me in the dark as to starting them at top, and I have no one better posted to ask, so come to you.

F. G. S., West Chazy, N. Y.

There is a little "Cement Workers' Handbook" (50 cents) by W. H. Baker, which will possibly supply the wants of our correspondent. It is "compiled to meet the requirements of the common workman" and so treats the subject somewhat more in detail regarding manipulation of forms and tools than does the "Handbook for Cement Users" ($3), which is intended for the contractor, engineer and the cement worker having some knowledge of his trade.

STRENGTH OF HOLLOW CONCRETE BLOCKS.

We desire to be informed as to what the crushing and tensile strength of a hollow concrete block should be when made for the construction of the ordinary two or three-story building. Also, have there been any concrete-block buildings anywehere that have collapsed because of the inferior quality of the blocks used in them?

K. C. THOMSON & CO.,
Greenville, Miss.

Reference may be made to the building ordinances printed in MUNICIPAL ENGINEERING for their requirements regarding strength of concrete and concrete blocks.

Minneapolis, vol. xxix, p. 441, requires that no wall be loaded to exceed 8 tons per superficial foot, and no blocks are to be used that will crush at less than 700 pounds per square inch in 28 days. Concrete for fireproofing must be so mixed that it has a crushing power not less than 2,000 pounds per square inch after hardening 28 days, and the floors must not be loaded before the concrete has reached this compressive strength.

Philadelphia, vol. xxix, p. 356, requires that no wall or any part thereof composed of hollow concrete blocks shall be loaded to an excess of 8 tons per superficial foot of the area of such blocks, and that the crushing strength at 28 days' age shall be 1,000 pounds per square inch, no deduction to be made in figuring the area for the hollow spaces. Concentrated loads of over 2 tons make solid blocks necessary, the number of courses of solid blocks to be used depending on the load. The modulus of rupture at 29 days' age must average 150 and not fall below 100, and the average compressive strength must average 1,000 pounds and not fall below 700 in any case. Tests of concrete blocks on the market made under the Philadelphia regulations show modulus of rupture 150 to 175 pounds and compressive strength 1,200 to 1,600 pounds per square inch.

Newark, N. J., vol. xxix, p. 358, requires 150 pounds tensile strength and 1,500 pounds compression test per square inch, presumably of net concrete section.

WHAT ARE NATURAL HYDRAULIC AND PORTLAND CEMENT?

Kindly explain difference between "natural, hydraulic and Portland cements."

H. J. C., Cincinnati, O.

Cement is any substance used for making bodies adhere to each other. Hydraulic cement is one which hardens or sets with the addition of water or under water. When this point in the subdivision is reached there is a closer classification and the hydraulic cementing materials are divided into hydraulic limes and hydraulic cements proper. Hydraulic limes are burned slowly at low temperatures, and ordinarily have large proportions of lime in their composition. Hydraulic cements are burned at higher temperatures and have lower percentages of lime and higher percentages of silica and alumina. The term "natural cement" would presumably cover any cement not artificial, but this term is often used to designate natural hydraulic cement, which originally covered hydraulic cements made by burning natural rock which had the proper composition. Portland cement is always a hydraulic cement, so that the word "hydraulic" is never used with it. This cement was originally an artificial mixture of chalk and clay or materials of similar composition burned very hard at a higher temperature than is suitable for

burning natural hydraulic cements. As the terms are now used, these definitions of Portland and natural hydraulic cements are not quite accurate, since some natural rocks can be burned at the hign temperatures and make high-grade cements which cannot be distinguished in general qualities from Portland or artificial hydraulic cements. At present, therefore, it is necessary to make the distinction on grounds of chemical composition and method of manufacture. Natural hydraulic cements are still made from natural rock and are burned at comparatively low temperatures, though higher than those at which limes and hydraulic limes are burned. They may contain a large percentage of magnesia and other materials which are not permitted in the artificial cements. Portland cements are made by "calcining to a point just short of vitrification a thorough mixture, consisting essentially of calcareous and clayey substances and grinding the product to the fineness of flour," as the German Association of Portland Cement Manufacturers states it. This thorough mixture may be a natural rock, a mixture of natural rocks, a mixture of clay or shale or slag and limestone or marl, or any form which will be equivalent. These two terms cover all the hydraulic cements in use except the hydraulic limes above referred to and the cements made by grinding together blast-furnace slag and quicklime, which latter are called puzzolan or slag cement.

CONCRETE CHIMNEY.

Can you give us any information as to the practicability of constructing a smokestack of a factory building from grouting put up in forms? What would the specifications need be as to the thickness of the wall and richness of material for a stack with 44-foot elevation and opening 3 feet 6 inches? Any data that you may be able to give us through the medium of your paper will be appreciated.

G. C. S., Lancaster, Pa.

The "Handbook for Cement Users" ($3) gives some information on this subject. It mentions a chimney in Germany constructed entirely of concrete. In this country, however, it is pratically the universal custom to reinforce the concrete with steel rods or bars. This is on account of the tendency of wind pressures to produce a tensile stress upon the concrete, which can be taken up by the steel reinforcing and thus make it unnecessary to make a thickness of concrete great enough to insure that there shall never be any tensile stress upon the concrete.

There are several systems of chimney construction in use in this country, using various methods of reinforcement. Information about these systems can be obtained from the firms using them, such, for example, as the Associated Expanded Metal Companies, New York city; Clinton Wire Cloth Co., Clinton, Mass.; Concrete-Steel Engineering Co., New York city; St. Louis Expanded Metal Fireproofing Co., St. Louis, Mo. The Cottancin, Ransome and Weber systems of reinforcing are also used in chimneys in this country. Reference to the "Business Directory," to be found in every number of MUNICIPAL ENGINEERING, under the headings "Civil Engineers," "Concrete Work," etc., will give names of persons competent to design concrete chimneys and of firms able to construct them properly.

Articles on concrete standpipe in MUNICIPAL ENGINEERING, vol. xxvi, p. 162, and on chimneys, in vol. xxvii, p. 372, may be referred to for additional information.

COST OF SMALL CEMENT PLANT.

I want figures on the installation of the smallest plant it is practical to establish for making Portland cement. We have a proposition where the plant would not be of much value after the completion of the work—at least we are not figuring on anything but present use. We would use 4,500 barrels of cement or more.

A. T. J., Denver, Col.

It would not be possible to put up a Portland cement plant anywhere in the United States so as to make it economical to manufacture so small a quantity as 4,500 barrels of cement. The United States government, under the peculiar conditions at the Tonto or Roosevelt dam in Arizona, deemed it advisable to reject bids for cement at $4.81 a barrel delivered at the work and to construct a plant to make cement of the excellent materials on the spot. They required, however, 200,000 barrels of cement and put up two kilns, which would make this amount in about 800 to 1,000 days.

An article on "Cost of Building and Operating a Portland Cement Plant" will be found in MUNICIPAL ENGINEERING, vol. xxvi, p. 391, which goes into the question in considerable detail. The estimates there given of $50,000 to $60,000 for total cost of plant for each kiln installed, including all the machinery and buildings, are for plants with several kilns, and a plant with a single kiln would cost more than this estimate per kiln. Modern kilns have increased the capacity of a mill per kiln from the former figure of 100 barrels a day to one of 200 barrels a day, or even more.

Even if the cost of making cement is only that estimated in the article, 80 cents a barrel, the cost of the plant at

the lowest figure, $50,000, when divided by the number of barrels to be made, say 5,000 to increase the estimate of the letter a little, makes the cost of cement per barrel $10.80, due to the fact stated, that the plant will be of no value after the cement wanted has been manufactured. The $6 difference between this low cost under the circumstances named and the bid of $4.81 for the Roosevelt dam will pay freight rates to any point in United States territory.

HOW TO WATERPROOF BASEMENT UNDER OUTSIDE WATER PRESSURE.

I have a basement that has twenty or thirty pounds of water pressure on outside of wall, which I cannot get at from outside. I have to work against head coming through a concrete wall of 1-2-4 proportions. It is a slow filter, running about 12 gallons in 24 hours. I used a waterproofing paint, but failed to stop leak. I see on page 206 in "Handbook for Cement Users" a mixture of cement, sand and hydrolite. Can you advise me where I can buy the latter.

G. B. S., Willsburg, W. Va.

Reference should be made to the articles entitled "How to Make a Cellar Wall Waterproof," in the October and December numbers of MUNICIPAL ENGINEERING, vol. xxix, pp. 292 and 426. These will give instructions which should bring success under ordinary conditions. The difficulty is increased when there is pressure from outside, tending to force the water through. It is then difficult to keep the plaster in place until the cement has hardened and attached itself to the older concrete. In case there are cracks or pores of size sufficient to show an appreciable rapidity of leakage it may be necessary to dig out the leaky spot and caulk the crack with oakum soaked in asphalt or in neat cement mortar, afterward plastering up to make a smooth surface. A pressure such as that mentioned would mean some 60 feet head of water. If possible, this head should be removed while the repairing is under way.

Hydrolite does not seem to be on the market at the present time.

CURING CONCRETE BLOCKS BY STEAM.

While preparing plans for a building for the making of cement blocks I came across a small article in your MUNICIPAL ENGINEERING treating upon the curing of cement blocks by steam. With a view to getting whatever information you can give relative to who are curing blocks in that way, together with getting your own ideas in that direction, I have postponed the construction of a shed for the present.

J. J. M., New York City.

It is understood that Mr. J. P. Sherer, of Milwaukee, Wis., has been making some experiments upon the curing of blocks by steam, which have thus far been successful, but as the experiments are not completed he is not willing as yet to give his results to the public. The blocks which he has tested were cured by placing them in a sand-lime brick curing cylinder. The time of curing is shortened to a very few hours, perhaps four hours' treatment being equivalent to as many weeks in air, thus making it possible, it is said, to use blocks the same day they are made. The steam heat at the pressure used, about 120 pounds, thoroughly tests the soundness of the cement used and thus requires the best possible materials.

The present difficulty is in the expense for ordinary block plants in installing a steam plant of sufficient size to supply the demand. A sand-lime brick curing cylinder can be used, and the combination of a sand-lime brick plant and a cement-block plant, where neither was overworked, might make an economical plant. Otherwise the steam plant required would probably be too expensive for even the largest block plants.

CONSUMPTION OF WATER IN SMALL CITIES.

Please give table of the per capita consumption of water in cities of this size.

G. W., Pocatello, Ia.

No tabular statement of this sort being available, the following has been compiled and computed from the data given in the "Manual of American Water Works" ($3), with a few changes and additions from other sources. The table includes the cities and towns reporting which are within the limits of 2,000 and 5,000 population according to the census of 1890.

The variation in consumption is very marked. This variation in figures is due to actual variation in consumption of water, to leakage, waste or other loss not recorded, to errors in measurement, which often give excessive consumption when the measurement is by count of pump strokes in a small plant not kept in the best of repair, and to lack of measurement and defects in the estimates made in reply to the inquiry for amount of total consumption. It is not possible to indicate where these various errors may be found.

The variations between 1890 and 1895 are due to variations in the amount of the above described items and errors, and also to errors in making the estimate of population in 1895.

These are the latest statistics for any appreciable number of cities of this size which are available.

City.	Population. 1890.	Population. 1895.	1890. Gals.	1890. Per-cap.	1895. Gals.	1895. Per-cap.
Bessemer, Ala.	4,544	5,451	120,000	26	900,000	165
Sheffield, Ala.	2,731	2,963	1,000,000	364	80,000	27
Talladega, Ala.	2,063	3,556	40,000	20	150,000	42
Phoenix, Ariz.	3,152	4,346	450,000	142	800,000	184
Eureka Springs, Ark.	3,706	3,961	.....	...	84,600	21
Fayetteville, Ark.	2,942	2,876	.....	...	100,000	34
Bakersfield, Cal.	2,626	2,736	100,000	39	100,000	36
Benicia, Cal.	2,361	2,419	150,000	63	250,000	104
Chico, Cal.	2,894	3,105	.....	...	454,500	151
Eureka, Cal.	4,858	4,932	275,000	57	250,000	51
Pasadena, Cal.	4,882	4,917	150,000	31	150,000	30
Pomona, Cal.	3,634	3,824	.....	...	1,300,000	338
Red Bluff, Cal.	2,608	2,624	600,000	230	1,000,000	38
Salina, Cal.	2,339	2,418	150,000	64	225,000	93
San Bernardino, Cal.	4,012	4,239	40,000	10	.....	...
San Luis Obispo, Cal.	2,994	3,169	.....	...	400,000	126
Santa Ana, Cal.	3,628	3,814	.....	...	425,000	118
Santa Clara, Cal.	2,891	2,915	.....	...	350,000	120
Ventura, Cal.	2,320	2,345	1,320,000	580	1,500,000	633
Canon City, Col.	2,825	3,785	.....	...	476,903	123
Central City, Col.	2,480	2,569	26,400	11	216,000	84
Durango, Col.	2,726	2,872	390,000	143	600,000	207
Greeley, Col.	2,395	2,416	173,414	71	600,000	247
Bethel, Conn.	2,335	3,314	150,000	64	350,000	106
South Norwalk, Conn.	4,875	5,733	1,225,000	252	1,000,000	174
Stafford Springs, Conn.	2,353	2,406	500,000	212	500,000	208
Westport, Conn.	3,715	3,866	.....	...	100,000	26
New Castle, Del.	4,010	3,695	450,000	...	450,000	121
Smyrna, Del.	2,455	2,312	28,000	11	50,000	22
Lake City, Fla.	2,020	3,016	.....	...	250,000	83
Orlando, Fla.	2,865	2,643	150,000	52	150,000	57
Palatka, Fla.	3,039	3,154	115,000	38	188,371	60
Albany, Ga.	4,008	4,307	.....	...	245,000	57
Cartersville, Ga.	3,171	4,021	.....	...	100,000	25
Dalton, Ga.	3,064	3,116	135,000	45	275,000	89
Griffin, Ga.	4,503	3,680	.....	...	200,000	54
Marietta, Ga.	3,384	3,915	.....	...	150,000	38
Valdosta, Ga.	2,854	3,012	.....	...	150,000	50
Waycross, Ga.	3,364	3,128	.....	...	205,000	66
Boise, Ida.	2,311	4,634	1,000,000	430	500,000	86
Moscow, Ida.	2,861	2,672	10,000	3	200,000	75
Pocatello, Ida.	2,330	3,188	50,000	21	250,000	79
Amboy, Ill.	2,257	2,429	.....	...	15,000	6
Belvidere, Ill.	3,867	3,918	.....	...	174,000	44
Carlinville, Ill.	3,293	3,168	.....	...	1,500,000	471
Carrollton, Ill.	2,258	2,547	50,000	22	100,000	39
Clinton, Ill.	2,598	2,698	70,000	27	257,000	95
Collinsville, Ill.	3,498	3,739	.....	...	40,000	11
De Kalb, Ill.	2,579	4,241	67,935	26	50,000	12
Dundee, Ill.	2,023	2,197	.....	...	100,000	45
Effingham, Ill.	3,260	3,154	.....	...	100,000	32
Galva, Ill.	2,409	2,387	.....	...	75,000	31
Havana, Ill.	2,525	2,948	.....	...	400,000	134
Highland Park, Ill.	2,163	3,759	.....	...	119,790	32
Hillsboro, Ill.	1,800	1,900	.....	...	75,000	39
Jerseyville, Ill.	3,207	3,354	30,000	9	50,000	15
Kewanee, Ill.	4,569	4,618	100,000	22	85,000	18
Macomb, Ill.	4,052	4,239	.....	...	100,000	24
Maywood, Ill.	2,076	2,154	.....	...	150,000	70
Mendota, Ill.	3,542	3,418	30,000	8	36,000	11
Minonk, Ill.	2,316	2,469	.....	...	60,000	24
Morris, Ill.	3,653	4,894	.....	...	9,000	2
Morrison, Ill.	2,088	2,149	200,000	95	250,000	116
Mt. Vernon, Ill.	3,233	3,268	43,000	13	300,000	92
Paxton, Ill.	2,187	2,397	700,000	318	50,000	21
Petersburg, Ill.	2,342	2,482	.....	...	700,000	278
Pontiac, Ill.	2,784	2,879	.....	...	750,000	259
Taylorville, Ill.	3,097	3,264	350,000	113	500,000	153
Brookville, Ind.	2,028	2,029	.....	...	135,000	67
Butler, Ind.	2,521	2,242	.....	...	200,000	90
Connersville, Ind.	4,548	5,321	.....	...	1,125,000	211
Decatur, Ind.	3,142	3,541	.....	...	60,000	17
Elwood, Ind.	2,284	2,593	.....	...	500,000	192
Greencastle, Ind.	4,390	3,472	.....	...	600,000	172
Greensburg, Ind.	2,596	2,981	.....	...	300,000	100
Martinsville, Ind.	2,680	2,862	.....	...	500,000	174
Mishawaka, Ind.	3,371	3,197	.....	...	350,000	108
North Manchester, Ind.	2,384	2,518	.....	...	100,000	40
North Vernon, Ind.	2,012	2,106	.....	...	100,000	47
Plymouth, Ind.	2,723	2,834	25,000	9	33,000	12
Princeton, Ind.	3,076	3,275	.....	...	100,000	30
Rockport, Ind.	2,314	2,346	75,000	36	100,000	42
Tipton, Ind.	2,697	2,839	.....	...	50,000	18
Union City, Ind.	2,681	2,768	156,000	58	200,000	72

City.	Population. 1890.	Population. 1895.	1890. Gals.	1890. Per-cap.	1895. Gals.	1895. Per-cap.
Warsaw, Ind.	3,574	3,654	300,000	84	500,000	137
Anamosa, Ia.	2,078	2,484	80,000	38	400,000	162
Atlantic, Ia.	4,351	4,137	350,000	80	400,000	97
Centerville, Ia.	3,668	3,891	.....	...	11,000	3
Cherokee, Ia.	3,441	3,267	65,000	19	44,000	13
Fairfield, Ia.	3,391	3,481	55,104	16	125,000	36
Hampton, Ia.	2,067	2,107	.....	...	60,000	28
Knoxville, Ia.	2,632	2,731	.....	...	120,000	44
Shenandoah, Ia.	2,440	2,208	.....	...	500,000	226
Beloit, Kan.	2,455	2,457	70,000	28	150,000	61
Cherry Vale, Kan.	2,104	2,233	50,000	24	150,000	67
Coffeyville, Kan.	2,282	3,572	.....	...	100,000	28
Columbus, Kan.	2,160	2,210	.....	...	40,000	18
Council Grove, Kan.	2,211	2,415	.....	...	80,000	33
El Dorado, Kan.	3,339	3,619	.....	...	120,782	34
Eureka, Kan.	2,259	2,568	500,000	220	480,000	186
Great Bend, Kan.	2,450	2,310	100,000	40	255,000	110
Horton, Kan.	3,316	3,469	.....	...	15,000	4
Independence, Kan.	3,127	3,433	.....	...	250,000	73
Junction City, Kan.	4,502	4,621	.....	...	125,000	27
Kingman, Kan.	2,390	2,537	50,000	21	1,000,000	390
Marion, Kan.	2,047	2,184	40,000	20	100,000	45
Oswego, Kan.	2,574	2,637	.....	...	300,000	118
Paola, Kan.	2,943	3,105	160,000	53	600,000	192
Danville, Ky.	3,766	3,832	.....	...	100,000	26
Elizabethtown, Ky.	2,260	2,435	.....	...	20,000	8
Glasgow, Ky.	2,051	2,135	38,400	19	40,000	19
Harrodsburg, Ky.	3,230	3,553	.....	...	65,000	18
Nicholasville, Ky.	2,157	2,254	.....	...	50,000	22
Paris, Ky.	4,218	4,312	.....	...	130,879	30
Richmond, Ky.	4,735	4,861	.....	...	200,000	41
Shelbyville, Ky.	2,676	2,342	.....	...	40,000	17
Somerset, Ky.	2,625	2,876	.....	...	250,000	87
Winchester, Ky.	4,519	4,614	.....	...	107,426	23
Alexander, La.	2,861	3,420	.....	...	15,000	4
Lake Charles, La.	3,442	4,987	.....	...	300,000	60
Monroe, La.	3,256	3,325	.....	...	165,000	49
Plaquemine, La.	3,222	3,106	.....	...	25,000	8
Thibodaux, La.	2,078	2,137	.....	...	30,000	14
Brewer, Me.	4,193	4,514	.....	...	800,000	178
Caribou, Me.	4,087	4,422	80,000	20	200,000	45
Richmond, Me.	3,082	2,565	47,225	16	57,000	22
Yarmouth, Me.	2,098	2,136	.....	...	40,000	19
York Beach and York Cliff, Me.	2,444	.....	.....	...	100,000	...
Cambridge, Md.	4,192	4,970	.....	...	600,000	120
Chestertown, Md.	2,632	2,824	50,000	19	100,000	35
Easton, Md.	2,939	3,006	40,000	14	100,000	33
Lonacoming, Md.	.....	2,181	.....	...	50,000	23
Salisbury, Md.	2,905	3,591	50,000	17	500,000	139
Westminster, Md.	2,903	3,001	.....	...	100,000	33
Whitman, Mass.	4,441	5,298	84,141	19	275,000	52
Falmouth Heights, Mass.	2,567	3,033	.....	...	5,000	2
Foxborough, Mass.	2,933	3,099	.....	...	141,030	46
Ipswich, Mass.	4,439	4,548	.....	...	100,000	22
Lexington, Mass.	3,197	3,514	.....	...	60,000	46
Mansfield, Mass.	3,432	3,719	176,563	52	139,000	38
Maynard, Mass.	2,700	2,921	.....	...	86,599	30
Nantucket, Mass.	3,268	3,137	.....	...	88,000	28
Needham, Mass.	3,035	3,525	.....	...	139,099	39
North Brookfield, Mass.	3,871	4,229	.....	...	96,319	23
Norwood, Mass.	3,733	4,601	168,842	45	169,000	37
Orange, Mass.	4,568	5,044	.....	...	137,502	27
Provincetown, Mass.	4,642	4,444	.....	...	80,000	18
Reading, Mass.	4,088	4,183	.....	...	198,289	47
Stoughton, Mass.	4,815	5,142	.....	...	240,000	47
Uxbridge, Mass.	3,408	3,503	25,000	7	25,000	7
Walpole, Mass.	2,604	3,033	25,000	10	75,000	25
Wellesley, Mass.	3,600	4,336	255,418	71	175,000	40
Abington, Mass.	4,260	4,374	.....	...	400,000	91
Ayer City, Mass.	2,148	2,247	.....	...	73,600	32
Barre, Mass.	2,239	2,149	.....	...	20,000	9
Canton, Mass.	4,538	4,061	79,107	18	182,372	45
Concord, Mass.	4,427	5,038	.....	...	500,000	100
Fairhaven, Mass.	2,919	3,243	.....	...	15,000	4
Allegan, Mich.	2,669	2,668	350,000	130	511,200	191
Bessemer, Mich.	2,566	2,731	.....	...	40,000	15
Cadillac, Mich.	4,461	4,521	1,000,000	224	905,975	200
Charlotte, Mich.	3,867	3,932	233,333	...	306,850	76
Greenville, Mich.	3,056	3,060	250,000	...	240,000	78
Holland, Mich.	3,945	4,132	150,000	...	1,500,000	36
Howell, Mich.	2,387	2,179	.....	...	250,000	115
Ionia, Mich.	4,482	4,349	340,000	...	400,000	91
Marine City, Mich.	3,268	3,549	110,584	...	110,584	31
Midland, Mich.	2,277	2,364	500,000	...	500,000	212

City.	Population. 1890.	1895.	1890 Gals.	Per-cap.	1895. Gals.	Per-cap.
Mt. Clemens, Mich.	4,748	4,821	400,000	...	600,600	124
Niles, Mich.	4,197	4,297	.....	...	350,000	81
Petoskey, Mich.	2,872	3,572	.....	...	250,000	70
St. Clair, Mich.	2,353	2,443	.....	...	480,000	195
St. Ignace, Mich.	2,704	2,437	40,000	15	130,000	53
St. Joseph, Mich.	3,733	4,444	.....	...	342,000	76
Three Rivers, Mich.	3,131	3,265	2,000,000	...	200,000	61
Traverse City, Mich.	4,353	4,163	205,000	59	1,300,000	311
Alexander, Minn.	2,118	2,342	50,000	24	353,000	149
Austin, Minn.	3,901	4,879	50,000	13	200,000	41
Crookston, Minn.	3,457	3,459	500,000	145	200,000	58
Lake City, Minn.	2 128	2,387	.....	...	85,000	35
Little Falls, Minn.	2,354	2,429	150,000	63	150,000	61
New Ulm, Minn.	3,741	3,862	.....	...	32,300	8
North Field, Minn.	2,659	2,879	.....	...	52,677	18
Owatonna, Minn.	3,849	3,918	.....	...	205,480	52
Waseca, Minn.	2,482	3,242	.....	...	60,000	18
Columbus, Miss.	4559	5,522	150,000	33	175,000	32
Yazoo City, Miss.	3286	3,615	.....	...	660,000	182
Aurora, Mo.	3482	3,692	.....	...	250,000	68
Boonville, Mo	4141	4,167	250,000	61	250,000	60
Brookfield, Mo.	4547	4,325	.....	...	40,000	9
Butler, Mo.	2812	2,916	.....	...	30,000	11
Clinton, Mo.	4737	4,790	.....	...	275,000	57
Kirksville, Mo.	3510	3,629	.....	...	40,000	11
Lexington, Mo.	4537	4,618	110,000	24	228,000	50
Marshall, Mo.	4297	4,189	225,000	52	275,000	65
Maryville, Mo.	4037	4,563	.....	...	287,671	62
Mexico, Mo.	4789	4,867	126,215	26	400,000	81
Poplar Bluffs, Mo.	2187	2,361	.....	...	60,000	25
Rich Hill, Mo.	4008	4,534	160,000	40	240,000	53
Warrensburg, Mo.	4706	4,863	.....	...	8,000	2
Washington, Mo.	2725	2,915	45,000	16	75,000	26
Great Falls, Mont.	3979	9,454	285,000	72	1,500,000	158
Kalispell, Mont.	2000	2,263	.....	...	160,000	70
Livingston, Mont.	2859	2,725	.....	...	200,000	73
Blair, Neb.	2069	2,678	.....	...	100,000	37
Columbus, Neb	3134	2,469	12,500	4	100,000	40
David City, Neb.	2028	2,168	.....	...	65,000	30
McCook, Neb.	2346	2,419	3,000,000	128	400,000	166
Schuyler, Neb	2160	2,397	.....	...	170,000	70
Seward, Neb.	2108	2,208	.....	...	35,000	16
Wahoo, Neb.	2006	2,079	140,000	70	150,000	71
Reno, Nev.	3563	4,082	.....	...	1,500,000	370
Exeter, N. H.	4284	4,103	88,611	21	179,494	44
Franklin and Franklin Falls, N. H.	4085	.....	.....	...	218,000	...
Lebanon, N. H.	3763	4,314	300,000	79	300,000	70
Littleton, N. H.	3365	3,715	192,000	57	350,000	94
Milford, N. H.	3014	.....	.....	...	97,232	...
Suncook, N. H.	5000	.....	.....	...	15,000	...
Asbury Park, N. J.	3500	3,824	.....	...	500,000	130
Bordentown, N. J.	4232	4,171	.....	...	500,000	120
Dover, N. J.	5000	5,469	25,000	5	75,000	14
Flemington, N. J.	1977	2,061	.....	...	150,000	72
Freehold, N. J.	2932	2,933	.....	...	150,000	51
Keyport, N. J.	3411	3,412	.....	...	60,000	18
Lambertville, N. J.	4142	4,334	.....	...	250,000	58
Madison, N. J.	3000	3,111	.....	...	150,000	48
Moorestown, N. J.	2300	.....	20,000	9	250,000	...
Princeton, N. J.	3422	3,661	65,000	19	200,000	55
Red Bank, N. J.	4145	4,796	.....	...	130,054	27
South Orange, N. J.	3106	3,857	.....	...	500,000	130
Summit, N. J.	3502	4,402	75,000	21	500,000	114
Vineland, N. J.	3822	4,096	120,000	31	125,000	31
Woodbury, N. J.	3911	3,999	213,000	54	300,000	75
Addison, N. Y.	2166	2,772	.....	...	75,000	26
Baldwinsville, N. Y.	3040	3,016	80,000	26	160,000	53
Ballston Spa., N. Y.	3527	3,725	600,000	170	600,000	160
Bath, N. Y.	3261	4,127	100,000	31	.....	...
Canajoharie, N. Y.	2089	2,095	577,592	274	577,592	274
Canton, N. Y.	2580	2,665	75,000	29	250,000	94
Carthage, N. Y.	2278	2,586	.....	...	70,000	27
Catskill, N. Y.	4920	5,702	536,000	108	621,850	108
Chester, N. Y.	2112	5,681	.....	...	300,000	178
Clyde, N. Y.	2638	2,572	40,000	15	160,000	62
Fairport, N. Y.	2552	2,520	.....	...	40,000	16
Fort Edward, N. Y.	4424	3,521	.....	...	500,000	144
Frankfort, N. Y.	2291	2,477	.....	...	130,000	52
Fulton, N. Y.	4214	4,746	.....	...	550,000	116
Geneseo, N. Y.	2268	2,343	.....	...	164,000	70
Greenport, N. Y.	2500	2,433	.....	...	60,000	25
Herkimer, N. Y.	4666	5,110	.....	...	323,451	63
Huntington, N. Y.	3028	3,100	.....	...	42,298	14
Irvington, N. Y.	2299	2,265	15,000	7	15,000	7

City.	Population. 1890.	Population. 1895.	1890. Gals.	1890. Per-cap.	1893. Gals.	1893. Per-cap.
Lowville, N. Y.	2511	2,431	.....	...	250,000	103
Lyons, N. Y.	4475	4,337	.....	...	350,000	81
Medina, N. Y.	4492	4,604	.....	...	250,000	54
Mount Morris, N. Y.	2286	2,343	70,000	30	70,000	30
Newark, N. Y.	3698	4,138	100,000	27	320,000	77
Potsdam, N. Y.	3961	3,902	.....	...	856,000	217
Tarrytown, N. Y.	3562	4,166	35,000	10	300,000	72
Walden, N. Y.	2132	2,590	.....	...	50,000	19
Waterford, N. Y.	3523	3,334	164,857	46	332,528	97
Watkins, N. Y.	2604	2,774	.....	...	225,000	81
Waverly, N. Y.	4123	4,294	.....	...	750,000	175
Fayetteville, N. C.	4222	4,446	80,000	19	300,000	68
Goldsboro, N. C.	4017	5,447	100,000	25	100,000	18
Greensboro, N. C.	3317	6,676	150,000	45	1,500,000	225
Salisbury, N. C.	4417	5,348	84,400	19	350,000	65
Wilson, N. C.	2126	2,825	.....	...	60,000	21
Ashland, Ohio	3566	3,826	.....	...	50,000	13
Athens, Ohio	2620	2,840	.....	...	107,500	37
Bellefontaine, Ohio	4245	4,542	500,000	118	750,000	165
Bryan, Ohio	3068	3,106	.....	...	1,000,000	321
Canal Dover, Ohio	3470	4,421	.....	...	36,700	8
Carthage, Ohio	2257	2,408	.....	...	45,000	19
Conneaut, Ohio	3241	4,132	.....	...	376,800	91
Coshocton, Ohio	3670	4,836	.....	...	300,000	62
Eaton, Ohio	2934	3,044	.....	...	55,151	18
Hicksville, Ohio	2141	2,361	.....	...	200,000	81
Hillsboro, Ohio	3620	4,105	.....	...	125,000	30
Kent, Ohio	3501	3,652	265,000	75	800,000	218
Leetonia, Ohio	3050	3,263	.....	...	97,000	30
Lisbon, Ohio	3000	2,654	.....	...	150,000	56
Lorain, Ohio	4863	4,931	550,000	112	1,500,000	305
Madisonville, Ohio	2214	2,557	.....	...	55,000	21
Marysville, Ohio	2870	2,454	160,000	56	750,000	306
Niles, Ohio	4289	5,878	.....	...	500,000	85
N. Baltimore, Ohio	2857	3,209	.....	...	189,000	59
Port Clinton, Ohio	2049	2,368	.....	...	300,000	142
Ravenna, Ohio	3417	3,596	225,000	66	600,000	166
Reading, Ohio	3621	3,348	.....	...	71,000	21
Sidney, Ohio	4850	4,921	300,000	62	500,000	101
Troy, Ohio	4494	4,187	24,000	5	24,000	6
Upper Sandusky, Ohio	3572	4,120	150,000	42	150,000	36
Wapakoneta, Ohio	3616	3,768	.....	...	65,000	17
Wellston, Ohio	4377	6,211	.....	...	250,000	40
Oklahoma City, Ok.	4151	7,094	.....	...	500,000	71
Baker City, Ore.	2604	4,632	150,000	57	300,000	64
Oregon City, Ore.	3062	3,274	350,000	116	1,000,000	304
The Dalles, Ore.	3015	3,419	500,000	166	900,000	263
Berwick, Pa.	2701	3,331	.....	...	1,000,000	300
Bridgeport, Pa.	2651	2,874	.....	...	20,000	7
Catasauqua, Pa.	3704	3,833	.....	...	200,000	52
Clarion, Pa.	2164	2,034	40,000	18	224,000	109
Gettysburg, Pa.	3221	3,358	.....	...	75,000	22
Greensburg, Pa.	4202	5,355	850,000	201	1,250,000	234
Hamburg, Pa.	2127	2,221	.....	...	125,000	56
Hollidaysburg, Pa.	2975	2,987	150,000	50	300,000	100
Houtzdale, Pa.	2231	2,208	.....	...	3,000	14
Irwin, Pa.	2428	2,435	35,000	14	200,000	82
Kittanning, Pa.	3095	3,498	.....	...	1,200,000	342
Lansford, Pa.	4004	4,446	40,000	10	525,600	118
Latrobe, Pa.	3589	4,133	600,000	165	1,500,000	362
Lewiston, Pa.	3273	3,862	.....	...	150,000	39
Manheim, Pa.	2070	2,997	.....	...	70,000	23
Marietta, Pa.	2402	2,435	.....	...	75,000	31
Minersville, Pa.	3504	4,159	200,000	57	500,000	120
Phillipsburg, Pa.	3245	3,255	.....	...	600,000	184
Reynoldsville, Pa.	2789	3,112	.....	...	110,000	35
Schuylkill, Pa.	3088	3,371	.....	...	250,000	74
Scottdale, Pa.	2693	3,472	.....	...	1,000,000	286
Shippensburg, Pa.	2188	2,703	500,000	229	200,000	74
Tarentum, Pa.	4627	5,050	.....	...	225,000	44
Tremont, Pa.	2064	2,006	.....	...	35,000	17
Waynesburg, Pa.	2101	2,322	.....	...	200,000	86
Wilkinsburg, Pa.	4662	8,274	.....	...	990,000	120
E. Greenwich, R. I.	3127	2,951	200,000	64	.....	...
Anderson, S. C.	3018	3,265	50,000	16	150,000	46
Orangeburg, S. C.	2964	2,734	.....	...	100,000	37
Deadwood, S. D.	2366	2,498	90,000	38	730,000	290
Huron, S. D.	3038	2,452	.....	...	500,000	204
Watertown, S. D.	2672	2,469	220,000	82	130,000	52
Yankton, S. D.	3670	3,815	.....	...	2,000,000	520
Bristol, Tenn.	3324	3,247	100,000	30	400,000	127
Cleveland, Tenn.	2863	3,360	.....	...	150,000	44
Johnson City, Tenn.	4161	4,353	.....	...	300,000	69
Murfreesboro, Tenn.	3739	3,869	.....	...	75,000	19
Beaumont, Tex.	3296	6,362	.....	...	750,000	118

City.	Population. 1890.	Population. 1895.	1890. Gals.	1890. Per-cap.	1895. Gals.	1895. Per-cap.
Brownwood, Tex.	2176	3,546	40,000	18	275,000	77
Bryan, Tex.	2979	3,089	.....	...	100,000	32
Cleburn, Tex.	3278	3,567	260,000	79	450,000	126
Columbus, Tex.	2199	2,245	20,000	9	45,000	20
Corpus Christi, Tex.	4387	4,163	.....	...	55,000	13
Cuero, Tex.	3442	3,682	.....	...	500,000	137
Denton, Tex.	2558	2,789	.....	...	50,000	18
Georgetown, Tex.	2447	2,694	150,000	61	250,000	93
Greenville, Tex.	4330	5,595	.....	...	175,000	31
Hillsboro, Tex.	2541	2,786	.....	...	175,000	62
Navasota, Tex.	2997	3,054	100,000	33	100,000	33
Oak Cliff, Tex.	2470	2,632	.....	...	300,000	114
San Marcos, Tex.	2335	2,187	500,000	21	750,000	34
Sulphur Springs, Tex.	3038	3,149	.....	...	50,000	13
Victoria, Tex.	3046	3,523	45,000	15	125,000	35
Waxahachie, Tex.	3076	3,645	.....	...	75,000	20
Bennington, Ver.	3971	4,313	84,141	19	500,000	92
Farmville, Va.	2404	2,437	.....	...	80,000	33
Newport News, Va.	4419	12,042	.....	...	1,500,000	125
Pulaski City, Va.	2112	2,702	.....	...	70,000	26
Ellensburg, Wash.	2768	2,252	.....	...	750,000	331
Olympia, Wash.	4698	4,282	.....	...	40,000	9
Port Townsend, Wash.	4558	4,613	.....	...	200,000	43
Charlestown, W. Va.	2287	2,339	800,000	347	100,000	43
Grafton, W. Va.	3159	3,752	.....	...	400,000	106
Hinton, W. Va.	2570	3,166	325,000	126	325,000	102
Moundsville, W. Va.	2688	4,025	.....	...	100,000	25
Wellsburg, W. Va.	2235	2,412	.....	...	100,000	41
Antigo, Wis.	4424	4,323	.....	...	125,000	29
Black River Falls, Wis.	2261	2,599	.....	...	50,000	19
Monroe, Wis.	3768	3,946	.....	...	500,000	126
Rice Lake, Wis.	2130	2,515	.....	...	150,000	60
Ripton, Wis.	3358	3,529	40,000	12	280,000	80
Stoughton, Wis.	2470	2,617	40,000	16	150,000	57
Tomah, Wis.	2199	2,218	.....	...	75,000	34
Washburn, Wis.	3039	3,493	30,000	10	40,000	11
Waupun, Wis	2757	2,576	.....	...	150,000	58
White Water, Wis.	4359	4,794	45,000	11	250,000	52

DATA REGARDING WATER-WORKS PLANTS.

I am especially interested in water-works plants. Have you any data on modern plants?

R. A. W., Architect, Buffalo, N. Y.

Such books as Turneaure's "Public Water Supplies" ($5) and Folwell's Water-Supply Engineering" ($4) are good books on this subject. There is also a book giving a number of designs for standpipes treated architecturally ($3), Hazlehurst's "Towers and Tanks for Water Works" (2.50), Goodell's "Water Works for Small Cities and Towns" ($2).

PRODUCTION OF CEMENT IN 1905.

Have you any data or statistics that would give approximately the amount of Portland cement manufactured in the United States to some recent date in the year 1905? W. J. P., Pittsburg, Pa.

No definite figures are yet obtainable. There are fairly good data, however, for an approximate estimate of the production of cement for 1905. The increase in production each year over the preceding year for the last four years has averaged 4,500,000 barrels, being 4,229,205 in 1901 over 1900, 4,519,417 in 1902, 5,112,329 in 1903 and 4,162,908 in 1904 over the preceding year. If the average annual increase in production is assumed to be the increase in 1905 over 1904 the total production in 1905 will be slightly over 31,000,000 barrels.

It is fair to assume this average, because most of the reports concerning operations of factories are to the effect that they have run at something like full capacity for a larger proportion of the year than for a year or two past. A larger number of cement projects have been discussed during the latter half of the year than for some years. Several new factories have come into operation. The conclusions to be drawn from these facts are that the supply of cement is no more than equal to the demand, and in some localities there is a marked shortage at reasonable prices. The effect of any material increase in the price of cement in reducing its use in construction is very noticeable, and the necessity of maintaining low prices, even in the face of great demand, has been demonstrated. While the amount of cement exported and imported is now small, when compared with the production in this country, the amount exported increased about 315,000 barrels in the first ten months of 1905 as compared with the same period in 1904. For the same time the amount of cement imported decreased about 150,000 barrels. Both these figures denote an increase in the demand on the domestic factories. It seems safe, therefore, to estimate the production of domestic Portland cement

during 1905 at 30,000,000 barrels, with the probabilities in favor of a larger amount.

EXPANSION JOINTS IN CONCRETE WALLS.

I see from a back number of MUNICIPAL ENGINEERING, under "Sidewalk Construction," that a ¼-inch expansion joint should be made about every 30 feet and filled with bitumen. Will this be advisable also in building the wall of a house say 60 feet long, and, if so, what form of bitumen is most practical?

F. W., Cave Springs, Ga.

The method of making expansion joints used by the Illinois Central Railroad is given in the "Handbook for Cement Users" ($3), p. 237. The tar-paper joint used by the New York Central Railroad is specified on page 40. The former does not use a bituminous filler, but if the wall must be water-tight there should be a bituminous coating, such as is found generally in the market for water-proofing purposes, which will cover the joint on the back and extend far enough each way to insure that water will not find its way into the joint, even if changes in temperature cause it to open slightly.

Reinforced concrete walls can be built more than 60 feet long without danger of cracks, and so can plain concrete walls if they are in the earth or otherwise protected from large variations in temperature, but the general experience has been that plain concrete masses exposed to the sun and air must have joints each 30 to 50 feet of their length, or they will form their own joints by cracking in irregular and unsightly lines.

The article on "Waterproofing Concrete Structures" in MUNICIPAL ENGINEERING, vol. xxviii, p. 140, gives some methods of applying bituminous waterproofing and some specifications for the materials, which will be of interest in this connection. A general statement of the methods of making concrete water-tight will be found in vol. xxviii, p. 44, in an article on "Cement as a Protecting Material." Details of methods of applying waterproofing materials will be found in vol. xxviii, p. 285, in an article on "Water Tightness of Concrete," which is now a part of a chapter in Taylor and Thompson's book on Concrete, Plain and Reinforced" ($5).

HOW TO BUILD DAMS.

Will you kindly tell us where we can get reliable information concerning the construction of dams, either of wood or concrete, for power purposes?

C. R., Logansport, Ind.

Wegmann's "Design and Construction of Dams" ($5), Schuyler's "Reservoirs" ($5), Turneaure's "Public Water Supplies" ($5), will probably give much of the information desired. Concerning the construction of concrete dams information can be obtained from the Amburs:n Hydraulic Construction Co., Boston, Mass., and from many of the civil engineers whose names will be found under that heading in the "Business Directory" published in each number of MUNICIPAL ENGINEERING.

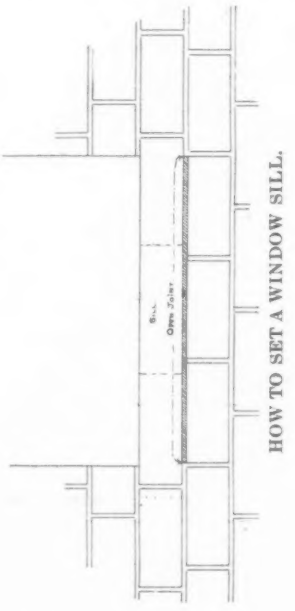
CRACKING WALLS UNDER WINDOWS.

In erecting buildings with cement blocks I have trouble in some of the blocks cracking. Thus far this has always occurred under the window frames, and naturally the sills and lintels crack also. I account for this that the jambs between the frames settle more than the walls under the frames, which are not as heavy, the stress appearing to be upward instead of downward. The same occurs in many brick walls, but the brick being smaller the cracks are not so conspicuous. I would like to learn through your valuable journal if there is any practical way to overcome this defect. I use blocks made of one part cement and four parts sand, the latter being ground sand rock.

JOHN P. BRICKER, Lititz, Pa.

The same difficulty occurs in brick buildings where proper provision is not made during construction for settlement.

Mr. Louis H. Gibson, architect, Indianapolis, Ind., who is the author of the articles on concrete block construction which are appearing in MUNICIPAL ENGINEERING, says that the trouble is probably due to the setting of the sills in full bed of mortar when they are first



HOW TO SET A WINDOW SILL.

set. The usual manner of taking care of the difficulty in both brick and concrete-block walls is to set the sills at first with joint full of mortar only at the ends, leaving a space under the sill for the whole width of the window space. The settlement of the wall can then occur during the construction without bringing the breaking strain upon the sills. After the work is completed and the settlement is presumably all done the open joints under the sills can be filled with mortar and the wall be thus finished. No cracks will then appear in either blocks, bricks, wall or sills under ordinary circumstances, and unless there is a great settlement, such as would come from insufficient foundation and bad design. The accompanying drawing shows the construction.

QUESTIONS FOR PLUMBERS' EXAMINATION.

Our sewer ordinance provides that all plumbers shall pass an examination before they can receive a license. I wish to know where I can procure a list of questions for such an examination.

T., ———, Mont.

Application to the building-inspection departments in New York and Chicago will doubtless procure copies of lists of questions which have been used in such examinations. Probably the secretary of the Board of Health of Montclair, N. Y., can furnish such a list. Price's "Handbook on Sanitation" ($1.50 net) gives a sample set of questions for a plumbing inspector.

GARBAGE DISPOSAL AND STREET-CLEANING DETAILS.

I am desirous of obtaining the following information: 1. What is the best treatise or statistics on garbage production, collection, disposal, etc., per capita? 2. What would you recommend to one who wants to get posted on street-cleaning details?

A. J. C., Chicago, Ill.

Reference should be made to the list of articles in MUNICIPAL ENGINEERING which will be found in the December number, vol. xxix, p. 429. To the books named there also may be added Chapin's "Municipal Sanitation in the United States."

Bulletin 20 of the Bureau of the Census on "Statistics of cities having a population of over 25,000 for 1902 and 1903" gives, in Table 12, a detailed account of the amount disposed of and the number of persons employed in getting rid of ashes, garbage, dead animals and other refuse and in cleaning streets. Table 21 gives the total expenditure for refuse disposal in each city. From this table and the populations of the cities the cost per capita can be computed. Following are a few of the results:

New York—Populuation 1903, 3,716,139; cost of refuse disposal, $78,144; per capita cost of refuse disposal, 2 cents.

Chicago—Population, 1,873,880; cost, $683,665; per capita, 37 cents.

Philadelphia — Population, 1,367,716; cost, $514,875; per capita, 38 cents.

St. Louis—Population, 612,179; cost, $266,937; per capita, 44 cents.

Boston — Population, 594,618; cost, $651,100; per capita, $1.09.

The average of cities above 300,000 population, 14 cities, is obtained as follows: Population, 11,449,463; total cost of refuse disposal, $3,227,132; average cost per capita, 28 cents.

The average of 23 cities reporting between 100,000 and 300,000 population is as follows: Population, 3,590,523; cost of refuse disposal, $835,315; per capita, 23 cents.

The average of 41 cities reporting between 50,000 and 100,000 population is as follows: Population, 2,905,502; cost of refuse disposal, $763,249; per capita, 26 cents.

The average of 77 cities reporting between 25,000 and 50,000 population is as follows: Population, 2,672,882; cost of refuse disposal, $434,644; per capita, 16 cents.

The average for the entire 155 cities in the country above 25,000 population reporting is as follows: Population, 20,618,370; cost of refuse disposal, $5,260,340; per capita, 25 cents.

In similar manner the results for any city or any group of cities can be derived from the data given in Bulletin 20.

The only place to get posted on street-cleaning details is in the street-cleaning force of a city having a good system. New York, Detroit, Washington, Buffalo may be mentioned as securing good results. Indianapolis recently installed a system to be operated by the city itself.

POWER FROM GARBAGE DESTRUCTOR.

The City Council has appointed a special committee to consider and report upon the advisability of establishing its own electric-light plant and the feasibility of utilizing a garbage disposal plant for the production of light and power.

I have no doubt that you have had in your journal from time to time articles which would be of service to the committee in dealing with this question. The committee is particularly desirous of obtaining tabulated statements of the cost and results in other cities.

L. FRED MONAGHAN, City Clerk,
Halifax, N. S.

But little has been done in this country toward utilizing garbage disposal plants

for the production of light and power. The city of New York has recently installed apparatus for burning dry refuse and utilizing the heat to produce steam. There have been several installations of small plants for burning the refuse from stores and factories and making steam, such as that described in MUNICIPAL ENGINEERING, vol. xxvi, p. 28. A large plant in the Philippines of similar nature, but burning miscellaneous city refuse, is described in vol. xxiv, p. 314, and the article contains a list of American installations of such plants.

England has been more successful in the destruction of waste and the utilization of steam produced thereby. The English plant at Burnley is described in vol. xxvi, p. 268, and that at Shoreditch, London, in vol. xxvii, p. 39. A general article on the differences in results and the reasons therefor will be found in vol. xxvii, p. 447.

Other articles on refuse, waste and garbage as fuel for steam production will be found in vol. xviii, p. 202; xvi, p. 303; xiv, p. 367; xiii, p. 348; xxvi, p. 238; xxv, p. 32; xx, pp. 140 and 170; xix, p. 349; xvii, p. 99. The articles on "Waste Utilization," vol. xxvi, p. 230; "Garbage Destruction for St. Louis," vol. xxvi, p. 257; "Systems of Garbage Collection and Disposal," vol. xxviii, p. 393; "The Steam Turbine in a Refuse Destruction Plant," vol. xxvii, p. 409; "Incineration of Municipal Waste," vol. xxix, p. 255; "The Functions of a Garbage Crematory," vol. xxix, p. 220; "Some Recent Garbage Crematories," vol. xxix, p. 59; "A Sanitary Garbage Incinerator," vol. xxix, p. 224; "The Branch Garbage Incinerator," vol. xxix, p. 224; "Portable Refuse Destructors," vol. xxix, pp. 228 and 366, will be of interest.

The books giving the best account of the English methods of utilizing the heat from burning garbage are Goodrich's "Disposal of Towns' Refuse" ($3.50) and "Refuse Disposal and Power Production" ($5).

The new bulletin, No. 20, of the United States Census Bureau on "Statistics of Cities having a Population of Over 25,000 for 1902 and 1903" gives figures of total cost of garbage and refuse disposal for many cities and the general results of operation of municipal lighting plants. There being no combined refuse destruction and light plants in this country, the only figures on cost of operating such combinations must be derived from Goodrich's books, above referred to, and the reports of English cities.

MUNICIPAL MATTERS IN COURT

Atlantic City's Ocean Front—Brick Trust Indictments—A Brick Trust Suit—Manhattan Bridge Contracts—Newark Paving Conuract—Assessment Against County—County Water Franchise—Illinois Public Improvements—Exclusive Garbage Contracts.

Atlantic City to Own Ocean Front.

Atlantic City will soon own all of the beach front as a park, the right to purchase all of the beach front riparian rights between Main and Jackson avenues having been granted December 15 by Governor Stokes, Attorney General McCarter and the Riparian Board. The purchase privilege is exclusive, as no rights are to be sold to private owners, who now own beach front property. The price is yet to be fixed by the Riparian Board, and the city is to complete its part of the sale arrangement not later than February 15. The city will acquire, by this decision, 3,000 feet of beach front rights.

Indictments against the Chicago "Brick Trust."

Indictments were returned by the grand jury at Chicago the first day of December in connection with the investigation which has been conducted into the methods of the so-called "Brick Trust." In each case the defendants were charged with conspiracy to injure the business of another, to prevent competition, and to re-

strict the production and sale of brick in the Chicago market. On December 18 the "Brick Trust" made a complete surrender to State Attorney Healy in court, and were fined $2,000 each, or an aggregate of $18,000. When the cases were called in court December 18, the attorneys for the defense announced that William H. Weckler, general superintendent of the Illinois Brick Company, had decided to turn state's evidence, and it was decided that the punishment inflicted on the other nine defendants should be remitted in his case. State Attorney Healy declared that he was willing that this action should be taken in Mr. Weckler's case, and the attorneys then entered pleas of guilty for all of the other defendants. The court assessed the fines of $2,000 in each case, and the amount was paid at once by the attorneys, and the defendants were dismissed. The defendants in the case were: George C. Prussing, president of the Illinois Brick Company; John H. Grey, sales agent for the same company; William H. Weckler, superintendent of the company; Edward J. Tomlins, sales agent of the Chicago Brick Company; John H. Shellhamher, sales agent for the American Brick Company; Patrick McMahon, business agent of the Brick, Sand, Lime and Terra Cotta Teamsters' Union; Charles Honk, business agent of the Brickmakers' Union; the Illinois Brick Company, Chicago Brick Company, American Brick Company.

Illinois Public Improvements without Petition.

An opinion handed down by Judge Hooper, of Ottawa, Ill., held that boards of local improvement can carry out their plans for paving and sewers and sidewalks independent of the usual formality of petitions of property owners. The court says:

There is absolutely no question regarding the new law providing for public improvements of all kinds, and boards of public improvements can do this kind of work without petitions from property owners.

A Trust Sues One of Its Members.

The Suburban Brick Company, of Wheeling, W. Va., has filed suit for $30,000 damages against George O. Robinson, a stockholder in the company, alleging a breach of contract. The company is composed of the Belmont Brick and Tile Company, George K. Wheat, B. F. Hogden and the defendant, George O. Robinson, and was consolidated under an agreement that no member of the combine should run a competitive business within a radius of fifty miles from Wheeling, according to the complaint. The petition says that Robinson, after placing $31,000 worth of stock in the Suburban Brick Company upon its consolidation, took upon himself the management of the Standard Brick and Stone Company, which sold its goods within the prescribed radius of fifty miles, and made it his business to take away the customers of the Suburban Brick Company.

Manhattan Bridge Contract Permanently Enjoined.

An order was issued by Justice Dowling, of the Supreme Court of New York, recently, continuing the injunction against the city of New York and the bridge department from awarding the contract for building the Manhattan bridge to the Pennsylvania Steel Company. The contract is held to be illegal because the specifications provided that a certain kind of material was to be used. As the Pennsylvania Steel Company was the only concern that manufactures this certain kind of material, the specifications shut out all competition. The chief engineer was also left as the sole judge of things, which the court thought should not be left to be decided by any one man. The city must either advertise again for bids and make a new contract, or appeal from Justice Dowling's decision to the appellate division of the Supreme Court before work can be resumed on the bridge.

County Water Franchise Not Valid in Subsequently Incorporated Town.

The Supreme Court of Washington handed down an opinion, November 23, sustaining the lower court in denying a writ of mandate to compel the town of Monroe to permit the Spring Water Company to connect its mains with residence and business houses. The company obtained a franchise from the county commissioners, and laid its mains before the town was incorporated. The court holds that the commissioners had no power to grant the franchise.

An Injunction against a Newark Paving Contract.

The Supreme Court of New Jersey set aside, December 4, the contract awarded August 24 by the Board of Works of Newark, to the Barber Asphalt Paving Company for repaving the approaches to the Sixth avenue bridge over the Montclair branch of the Lackawanna railroad

with bituminous macadam. The court held that Newark's interests were not sufficiently protected, and no proper opportunity for competitive bidding was afforded. Warren Brothers Company, of Boston, obtained the writ of certiorari upon which the Supreme Court acted, on the ground that bituminous macadam resembles bitulithic.

Assessment against County Property Invalid.

An opinion delivered by County Attorney Wilson, at Walla Walla, Wash., is to the effect that the county is not liable for any part of the expense of paving that part of Main street in front of the court house. He holds that the law passed by the last Legislature, making county property assessable for local improvements, did not go into effect until June, long after Main street was paved. The statute not being retroactive, the county escapes paying $4,150 charged against it, and the expenses must be borne by the city.

Exclusive Garbage Contracts Can Be Made.

The United States Supreme Court handed down an opinion, November 27, sustaining the ordinances of the cities of Detroit and San Francisco granting exclusive contracts for the removal of garbage. The court held that municipalities have the right to exercise police control over such matters in the interest of the public health. Rival concerns to the companies receiving the contracts began the litigation in both instances, and carried it up through the courts, losing at every point. Justice Harlan held that garbage could not be considered as private property, being taken for public uses without compensation. It constituted only the destruction of a nuisance. Justices Peckham and Brewer dissented.

DATA ON MUNICIPAL PROBLEMS

Garbage Incineration for St. Louis—Civic Federation Committee Program—The Independent League—Civic Education Centers—Grand Rapids Charter—Rates for Lighting.

Garbage Incineration for St. Louis.

Mr. Joseph G. Branch, inspector of boilers and elevators for the city of St. Louis, recently presented to the sanitary committee of the St. Louis City Council a report upon garbage reduction and incineration, from which the following extracts are taken to show his opinion regarding the proper method to adopt and his reasons therefor:

I respectfully submit for your consideration the following deductions from official statistics collected by me of garbage and refuse disposal in the different cities of this country and Europe, and comparison of the reduction and incineration methods, both as to their sanitation and cost. It is admitted by all engineers that England is at least fifty years in advance of this country in the collection and the disposal of its garbage and refuse. It is further admitted that until recently both the reduction and incineration methods were in an experimental stage in this country. It was only after the reduuction method had been tried and failed in England that incineration was adopted there, and to-day there is not one municipal reduction plant in England, so far as I have been able to ascertain, while there are 143 municipal incinerating plants in successful operation, 120 of which plants supply, without extra cost, their different cities with electric lights or power for their street railways, water works or sewerage systems. In addition to the above number of incinerating plants in England alone the three principal cities of Scotland and the eight large cities of Ireland dispose of their entire refuse by incineration. There is not a large city in Europe, South America, Africa, India or Australia which does not do likewise, and in every one of these different cities and countries the waste heat from the incinerating furnaces is utilized for municipal purposes of some

description, usually for electric lighting, pumping or mortar mills.

The average cost per ton for disposal of the refuse in the English cities is 26 cents, and in only six of these cities does the cost of disposal exceed 40 cents per ton. In Vienna, where the system of garbage reduction or utilization originated, it is not at present used, and I can ascertain no city in Europe which is at present using the reduction method.

A report of James C. Bayles shows that the reduction process has been a failure in every city in this country which has tried same, and especially so in Denver, St. Paul, Buffalo, Chicago, Milwaukee, Detroit, New Bedford, Reading, Pittsburg, Syracuse, Paterson and New Orleans.

There is but one municipal reduction plant in operation in this country—the one at Cleveland, O.—and as to what success this city is having, it is sufficient to say that her sister city, Columbus, O., is now having estimates prepared for an incinerating plant. Mr. Bayles writes that "The Cleveland collection of garbage and dead animals in 1902 was 12,640 tons. The subsidy paid by the city for collection and treatment under a ten-year contract was $15,800, or $1.25 per ton. The company claims to have received that year from the sale of by-products about $30,000, or $2.57 per ton. They also say their net loss was $5,000, or 40 cents per ton. The total of these figures would make the cost for collection and reduction a trifle over $4 per ton. Of this probably $1.75 represented the cost of collection, and the balance, or $2.25, the cost of the company to operate its plant and pay salaries."

It has been repeatedly stated that the success of incineration in England and foreign countries was no criterion for American cities, as the composition of the refuse of this country is entirely different, it being more moist and not having the same calorific values. This is incorrect. Official analysis shows but little difference where the whole refuse is collected, which includes all ashes, street sweepings and combustible waste, as is done in England and in all foreign countries. The refuse of the average American cities is of the following composition:

	Per C't. Weight.	Per C't. Volume.
Garbage	13	18
Ashes	80	57
Rubbish	7	25

Ordinary kitchen garbage consists approximately, by weight, of:

	Per C't.
Animal and vegetable	20
Rubbish, cans, rags, etc	7
Grease	3
Water	70

To cook the raw garbage and separate it into the four substances—*i. e.*, rubbish, water, grease and fertilizer material—is the object of all reduction systems. The rubbish itself being tin cans, rags, etc., has scarcely enough value to repay its separation, while the water has no value at all. These two ingredients compose 77 per cent. of all garbage, and the expense of their separation constitutes the chief expense of all reduction plants. The remaining 23 per cent. is of value, and should not be destroyed without some financial return, but it is equally as true that the high temperature necessary for the complete incineration of refuse should not be wasted up the stack, but utilized for power purposes. This is apparent from repeated demonstrations that the waste heat from a 150-ton incinerator will develop 1,200 horsepower, which is 895 k. w. of electric current, and smaller incinerators in like proportions. The loss from the failure to utilize this power would be greater than the loss from attempting to reduce the entire city refuse. The clinker which is left as a residuum forms 30 per cent. of all the garbage and refuse incinerated, and this by-product has a ready sale and is especially valuable for street and paving purposes. The city of Memphis, Tenn., has twenty miles of her streets made from this clinker. It makes a high-grade mortar and is otherwise extensively used.

Should this city collect all its refuse, including its ashes and combustible waste, as can be done by ordinance, there is not the slightest doubt but incineration will be a complete success, the same as in all the above-named cities, and at a cost not exceeding 15 cents per ton for its disposal, provided the waste heat is utilized. But to attempt incineration without making use of the ashes, which contain at least 20 per cent. coal, and consequently are of a high calorific value, and the further use of all combustible waste, consisting of street sweepings, boxes, etc., the cost will be excessive and impractical if the waste heat is not utilized.

It has been clearly shown that where incineration failed in this country it was due to improperly constructed furnaces and attempting to burn the wet garbage alone, without the aid of the combustible refuse. This is as great a mistake as to employ the reduction method without requiring a sorting of all refuse by the householder. As only 23 per cent of the refuse of a city is capable of reduction it leaves the remaining 77 per cent. to be disposed of by incineration. Whether the city can best dispose of this 23 per cent. by selling the same outright, as it is partially doing, or by reducing it at its

own municipal plant, or by incinerating it with the other refuse, is a question for your honorable committee. Should the incinerating method be adopted, either in part or for the entire refuse of the city, no incinerator should be accepted, in my opinion, which does not provide for the utilization of the waste heat under boilers should it at any time be desired to use same, and I base my opinion upon the fact that of the 184 incinerating plants in successful operation there is not one which does not utilize the waste heat therefrom under boilers. I know of no method other than the use of boilers, separate and distinct from the incinerator, which is either practical or will develop more power than is merely necessary for the operation of the incinerator itself. For such power purposes the use of water-jacketed furnaces is impractical, while the use of an auxiliary furnace as a stench destroyer renders the use of boilers for such purposes impossible, and is also antiquated. I know of only three plants out of the above number of 184 plants employing such a stench destroyer, it being entirely unnecessary in a properly built furnace.

As the cost of collecting the garbage and refuse constitutes 75 per cent. of the total cost, there should be at least four incinerators located in different sections of the city, or three incinerators and one reduction plant for the animal and grease matter alone, reducing as far as possible the length of the haul. At present some of the wagons are able to make only two trips a day, and several only one trip. The city at present is paying about $40,000 annually for the lighting of the public buildings. This can be saved by having built properly constructed furnaces and utilizing the waste heat therefrom for boiler power.

Plans for Investigation of Municipal and Private Ownership by Civic Federation Committee.

The committee of twenty-one, formed by the National Civic Federation to investigate the comparative results of private and municipal ownership and operation of gas, electric and water plants and street railways, met in New York City recently. The committee resolved to visit in a body such of the municipal plants in this country as may be selected as fairly presenting the measure of financial and operative success or failure attained by municipally owned and operated plants in America. Also to visit such privately owned gas, electric, street railway and water supply plants as may be open to its inspection, and later to visit Europe in a body and examine into the operation and effect of the various forms of management of public utilities. The committee will probably begin in the early part of January the examination of the conditions in this country, and then go to London, arriving the first day of June. In the meantime, a sub-committee will be sent to England and the continent to prepare the work in advance.

Among those present at the meeting were the following:

August Belmont, president of the National Civic Federation; Melville E. Ingalls, Cincinnati, chairman of the committee; Edward A. Moffett, secretary, Indianapolis; Talcott Williams, Philadelphia; W. D. Mahon, Detroit, Mich.; Walton Clark, Philadelphia; Edward W. Bemis, Cleveland; John H. Gray, Evanston, Ill.; Walter L. Fischer, Chicago; Frank Parsons, Boston; John R. Commons, Madison, Wis.; F. J. McNulty, Washington, D. C.; Albert E. Winchester, South Norwalk, Conn., and Charles I. Edgar, Boston.

The Independent League.

The Municipal League announced, December 12, that the organization will extend its work throughout the State and country under the name of the Independent League. Articles incorporating the league have been signed, and among other things the petition for incorporation states that the league is formed to "voluntarily obtain and promote by educational means and political action such legislation as will secure independence among electors, an administration of government independent of corporate and corrupting influences, and the application of public property to public uses." The petition for incorporation was signed by eleven directors, as follows: William Randolph Hearst, Samuel Seabury, Thomas Gillerman, James G. Phelps Stokes, C. Augustus Haviland, Max F. Ihmsen, Joseph Palmieri, Melvin G. Pallister, John Ford, Clarence J. Shearn and Bird S. Coler.

Civic Education Centers in Chicago Parks.

A series of lectures and entertainments to be given in the Field Houses in the new small parks in the South Park System, at Chicago, has been decided upon by the South Park Commissioners and the directors of the Municipal Museum, who have arranged to co-operate in the work. The audience rooms of the Field Houses

will be opened six evenings in the week, three of which will be devoted to lectures of an entertaining and educational character. A fourth evening will be devoted to a musical and recreation program under charge of one of the settlements. Another evening will be open to free discussion, when a chairman from the Municipal Museum will preside and present a neighborhood problem of local interest, and several other persons from the museum will be scattered through the audience and lead in the argument with the intention of arousing a debate. Another evening will probably be given to the presentation of matters of health and city sanitation. A number of lecturers have been engaged to fill the year's program.

The New Grand Rapids Charter.

Grand Rapids, like many other cities of its size, had for many years lived under an out-of-date charter. The city law had grown out of the original scheme for governing a village little by little and patch by patch. At the time of the last compilation in 1901, it required 30 pages of the charter to give the titles of the acts relating to the government of the city, of which the charter was the outgrowth. Three years ago the Civic Club of Grand Rapids, which is an active affiliated member of the National Municipal League, began advocating the general revision of the charter for the purpose of securing improvements in three general directions:

1. Better protection of the city's rights in the matter of municipal franchises.
2. More equitable assessment of the cost of street improvements.
3. The introduction of the merit system.

The demand for a new charter was sufficiently strong so that the common council passed a resolution asking the Legislature to establish a special charter commission. A charter commission bill was introduced at the legislative session of 1903, and was passed by both houses, though in slightly different form. But certain personal jealousies entered in to hold the matter up, and the charter commission bill died in conference committee. The following autumn the matter was taken up again by the city council, and the mayor was authorized to appoint a charter commission. This he failed to do, however, and the matter dragged along until May, 1904, when a new administration came into power and it was determined to entrust the revision of the charter to the charter amendment committee of the common council.

The new mayor appointed an especially strong committee; this committee proceeded on the plan of revising the old charter rather than making an entirely new one. Many radical changes, however, were made, especially with reference to franchises and municipal ownership, upon which the old charter said almost nothing. The committee secured the co-operation of various departments of the city government, the Civic Club and the Board of Trade in drafting the charter, which was then submitted to the common council for its approval. Some changes were made and the document was transmitted to the local members of the State Legislature. Two or three public hearings were held by them and a number of important alterations in the document made, chiefly in the direction of restoring the provisions as first drafted by the committee. The bill was then introduced into the Legislature, passed and took effect September 1st, this year.

The charter is not exactly a "model" charter, and it is not built on strictly scientific principles or according to a general plan, but in many places it reflects the influence of the municipal program of the National Municipal League. The common council, over which the mayor presides, continues to be the central authority of the city. There are four executive boards of five members each having charge of the following departments: One — Public Works, including water works, lighting plant, streets, sewers, bridges, public buildings, etc. Two—Police and Fire. Three—Health and Poor, including, besides the adminstration of charities and the care of contagious diseases, the control of garbage disposal, inspection of food and meat supplies, sanitary plumbing, etc. Four—Parks and Cemeteries.

The members of these boards are appointed for periods of five years on the rotation plan, so that one goes out of office each year. The mayor is a member of each board, without the right to vote. He has no power to remove board members except for misconduct or neglect of duty. Street cleaning, the cleansing of sewers and the repair of unimproved highways remain in the hands of the highway commissioners elected by districts. The office of city marshal as general executive official of the common council with special reference to streets is retained. Building inspection remains in an independent bureau under a building inspector appointed by the mayor, subject to confirmation by the common council. The common council remains as formerly, consisting of the mayor and two aldermen from each of the twelve wards of the city. The city attorney, the city clerk, the city treasurer, the marshal, the comptroller and the

mayor are all elected for terms of two years. The treasurer becomes the sole receiving officer of the city, and the comptroller becomes the chief bookkeeper and auditor, having power, subject to the common council, to prescribe forms of accounts, receipts, requisitions, etc., for all departments.

In addition to the foregoing boards and officers, there is a board of three assessors whose duty it is to assess property for taxation. There is also a board of sinking fund commissioners, composed for the most part of ex-officio members, whose duty it is to care for the city's debt. There is also a board of estimates composed of the principal city officials ex-officio, the committee on ways and means of the common council and three citizen members appointed by the mayor. This board is an innovation. It will have no authority, however, beyond recommending the budget. The council will be authorized to increase, decrease, add or strike out any items. There is also a board of library commissioners, consisting of five members, elected on a non-partisan ticket, one each year.

One radical change in the administrative side of the city government is in the department of education. Here, under the new charter, beginning with May, 1906, the city will have a school board of nine members elected at large, instead of a board consisting of the mayor and twenty-four trustees elected by wards. The school trustees will be elected at the regular municipal election, but on separate non-partisan ballots, nominations being made by petition. Women are eligible as voters, and also for election on the school board or the library commission. The administration of schools is connected with the general administration of the city by several links. The city treasurer will be the treasurer, and the city comptroller the auditor of the school board. The school budget, although prepared by the school board, must be submitted to the common council for amendment or approval. School bonds must be authorized by the common council.

In regard to the larger questions of municipal policy, the new charter makes certain radical changes. Heretofore the rule in Grand Rapids has been that abutting property should pay for the paving and repaving of all streets. In the new charter the city at large will pay for the paving of street intersections. Under the old charter there was no provision whatever for the merit system in any municipal department. Under the new charter the council is authorized to establish this system in the administration of any public utility owned by the city. In the old charter the power of the council to grant franchises by majority vote was practically unlimited and there was no general provision for municipal ownership. Under the new charter municipal ownership is made possible and the grant of franchises is carefully safeguarded. Under the old charter there was no provision for the referendum except with reference to certain bond issues. Under the new charter the referendum on most bond issues and on the purchase or sale of a public utility is obligatory, while the optional referendum is provided for on all ordinances, franchise grants or contracts involving the expenditure of more than $10,000, except for street or sewer improvements. In order that the optional referendum may be put into effect, petitions signed by 12 per cent. of the voters as shown by the last city election must be filed within thirty days after the passage of the measure to which the referendum is sought to be applied. Under the old charter there was no method provided for securing charter amendments and the city was dependent upon the caprice of the legislature, following the suggestions of the common council or of other local interests. Under the new charter, provision is made for amendments by means of the advisory initiative. Any citizen or body of citizens may draft charter amendments and circulate petitions in their favor. If these petitions are signed by 12 per cent. of the voters, the names being duly verified, the common council must submit the amendments to a vote of the people. If approved by the people, the amendments will go to the state legislature with the official request of the city that they be enacted into law.—*National Municipal League.*

Data Regarding Rates for Lighting.

The city clerk of Altoona, Pa., was directed, sometime ago, to secure data relative to the cost of electric lighting in the several cities. His report, which was submitted a few weeks ago, shows the following:

Where cities own their own plants:	
Detroit, Mich.	$34.99
Nashville, Tenn.	40.00
Chicago, Ill.	53.51
Norristown, Pa.	59.48
Burlington, Vt.	65.00
Cities in which contracts exist and where there is competition;	
Johnstown, Pa., five-year contract.	$40.00
Harrisburg, Pa.	47.00
Erie, Pa.	58.40
Cincinnati, O.	60.00
Saginaw, Mich., ten-year contract.	60.00
Portland, five-year contract	63.60
Peoria, Ill.	65.00
Kansas City, Mo.	65.00
Seattle, Wash.	66.00
Oswego, N. Y.	66.00
Evansville, Ind.	67.00
Baltimore, Md.	67.49

Dayton, O., ten-year contract.....	68.50
New Orleans, La.	69.00
Superior, Wis.	70.00
Denver, Colo.	70.00
Cleveland, O.	73.56
St. Louis, Mo.	74.95
Buffalo, N. Y.	75.00
Montgomery, Ala.	75.00
Knoxville, Tenn.	75.00
Mobile, Ala.	75.00
Birmingham, Ala.	75.00
Davenport, Iowa	75.00
Charleston, S. C.	75.00
Atlanta, Ga.	75.00
Atlantic City, N. J.	75.00
Chattanooga, Tenn.	77.88
Rochester, N. Y.	78.47
Lexington, Ky.	78.50
Elmira, N. Y.	80.00
Los Angeles, Cal.	81.00
Binghamton, N. Y.	83.95
Louisville, Ky.	84.00
Memphis, contract runs to 1935...	85.00
Washington, fixed by Congress....	85.00
Syracuse, N. Y.	85.78
Scranton, Pa.	86.40
Manchester, N. H.	90.00
Lawrence, Mass.	90.00
Lancaster, Pa., increase from $85.	93.50
Minneapolis, Minn.	94.00
Newark, N. J.	95.00
Pittsburg, Pa.	96.00
Trenton, N. J., increase from $92.87.	97.25
Jersey City, N. J.	97.50
Philadelphia	99.00
Hoboken, N. J.	100.00
Fitchburg, Mass.	100.00
Paterson, N. J.	101.00
Lynn, Mass.	102.20
Fall River, Mass.	109.50
Utica, N. Y.	109.50
Worcester, Mass.	109.50
Providence, R. I.	109.50
Boston, Mass.	120.45
Camden, N. J.	120.50
Albany, N. Y.	121.80
New York City	130.00

The city of Pittsburg, Pa., which has also been investigating the prices paid for street lighting, finds that it is paying more for its lights than other cities. Pittsburg pays $96 a year for each arc light, while the prices paid by some of the other cities are as follows:

Washington, D. C. $89.00	
Wilkinsburg	80.00
Butler	80.00
Bellevue	70.00
Homestead	75.00
Tarentum	75.00
Buffalo	75.00
Cincinnati, underground	72.00
Cincinnati, overhead	60.00
Monessen	72.50
Cleveland	73.56
Carnegie	70.00
McKeesport	70.00
New Kensington	69.00
Beaver	55.00
Detroit	59.34
Etna	55.00
Brownsville	50.00
York	49.27
Harrisburg	47.50

Some interesting and instructive information concerning municipal lighting in Detroit, substantiating the argument in favor of a municipal plant which is being raised in Pittsburg, was produced, as follows:

Detroit built a light plant ten years ago at an expenditure of only $872,726 for land, plant and full equipment, and the price of light to the city has been reduced to $59.34 for an arc lamp, which is the gross cost, including the cash cost of operation, loss by depreciation of lamps, machinery, etc., depreciation on investment and loss of taxes through municipal ownership. The actual cash cost in Detroit for maintaining a municipal light plant is only $34.99 for an arc lamp.

Prior to municipal ownership Detroit was compelled to pay to a private lighting company for the illumination of streets, $128.87 to $239.94 per arc lamp. Detroit has about the same number of arc lamps as Pittsburg, the number operated there this year being 2,818. The report of the light commission of Detroit says were all the property under the control of the public lighting commission obliterated, including the land upon which the plant stands, the whole cost to the city of Detroit for the past ten years, from June 30, 1895, to June 30, 1905, would have been $87.63 per arc lamp per annum.

Toledo, Ohio, too, has been securing data on gas lighting. This city passed an ordinance in 1901 setting the price for artificial gas for ten years at net rate of 95 cents per 1,000 cubic feet for illuminating purposes, and 70 cents for fuel purposes. The price for electric lighting has never been regulated by ordinance, and it is claimed that the price is not only exorbitant, but that serious discriminations exist. An ordinance introduced in council recently to regulate the price of commercial electric lighting is regarded as a beginning only of the fight in that city. Data secured by Toledo show the following:

A council committee in Dallas, Tex., has just agreed that the rate for gas shall be $1.35, with 10 cents off for prompt payment.

Chicago is in the courts now trying to enforce a rate of 75 cents.

Montreal has decided to put the gas privilege up to competition in order to secure 80-cent gas.

In Omaha the rate charged is $1.20, and the city is fighting for dollar gas.

In Springfield, Mass., the company has just reduced the price from $1 to 95 cents, but the city holds that as the company is paying 12 per cent. dividends and still holding back part of the profits, it can afford to give a much better rate.

The company in Boston has just agreed to furnish 90-cent gas, and has further agreed to maintain its capitalization at the present figure as a guarantee to the city against watered stock.

In San Francisco, where competition has recently arisen, the rate has been reduced from $1 to 75 cents.

Indianapolis characterizes its 90-cent rate as "outrageous," and demands a 60-cent rate.

Gas rates in some English cities are as follows:

Birmingham, 44 to 60 cents; *Manchester, 54 cents; Nottingham, 52 to 64 cents; *Paisley, 62 cents; Leeds, 54 cents; Bradford, 44 to 50 cents; *Glasgow, 50

cents; Aberdeen, 68 cents; *Leicester, 56 cents; Belfast, 54 cents.

London, 54 to 72 cents; Liverpool, 64 cents; Newcastle-Upon-Tyne, 36 to 48 cents; *Hull, 48 to 60 cents; Bristol, 54 cents; Cardiff, 68 cents; Portsmouth, 56 cents; Sheffield, 36 to 44 cents; West Ham, 70 cents.

The rates charged for electric lighting in Toledo are said to vary from 2 to 13 cents a kilowatt.

The municipal plant at Monroe is said to make the cost about 13 cents a kilowatt, while a private corporation offers a price of 4 cents.

Decatur, Ind., has a rate of from 6 to 8 cents a kilowatt, according to the amount used.

*These cities have a flat rate for gas, there being no discount. In all other cities in the table discounts for prompt payment or according to consumption are allowed, but are not included in the estimated rates.

SEWAGE AND REFUSE

Garbage Ordinance—Asphalt Pipe Joints—Tankage of Sewage—Pooling Agreement Void.

Garbage Ordinance.

Inquirers for ordinance provisions will find the following from Article XII of the health ordinance of Chicago of assistance in framing the general provisions for preventing nuisance from the accumulation of garbage and in its removal, copy of which has been sent by Perry L. Hedrick, chief sanitary inspector:

No person shall vend or attempt to vend or dispose of in the city any fruit, vegetable or other article of food that may be decayed or partially rotten, or that may have been taken from any barrel, box or other receptacle for the same, in any alley or street in the city.

No person or corporation owning or controlling any cart or vehicle used for the carrying or transporting of any offal, swill, garbage or rubbish, or the contents of any privy, vault, catch basin or sink, or having upon or in any such cart or vehicle any manure or other offensive or nauseous substance, shall cause or permit such cart or vehicle when in use for such purpose to stand or remain before or near any building, structure or premises occupied by any person; nor shall any such person or corporation using any such cart or vehicle cause or permit the use of an unreasonable or unnecessary length of time in and about the loading or unloading of any such cart or vehicle when in use for such purposes or cause to permit an unreasonable or unnecessary length of time to be used in passing along any street or public way; nor shall any such person or corporation cause or permit any such cart or vehicle to be in a condition needlessly or unnecessarily filthy or offensive.

Such person or corporation shall cause all such carts or vehicles used for such purposes and all implements used in connection with the loading or unloading thereof, when not in use, to be stored and kept in such place and in such manner as not to create a nuisance; and such person or corporation shall cause all such carts or vehicles and implements to be thoroughly disinfected and put in an inoffensive condition when so stored or not in use; and such carts or vehicles and implements shall be thoroughly disinfected at least once a week, whether in use or not, unless the same shall not have been used since the last disinfection thereof.

No person or corporation owning or controlling any cart or vehicle described in the last preceding section and used for the purpose therein mentioned shall cause or permit any such cart or vehicle to be so loaded or to be in such defective condition or so out of repair or of such faulty construction, or to be so improperly driven or managed that any manure, garbage, rubbish, offal, dirt, offensive liquid or other material with which such cart or vehicle is loaded shall drop or fall upon or in any street, public way or other place; and such cart or vehicle and any box, can or other receptacle carried thereon or therein, and in which any of the substances described in this or the preceding section shall be carried shall be so constructed as to be strong and practically air and water tight, so as to effectually prevent the same from emitting any odor and so as to prevent any part of the contents or load thereof from falling, leaking or spilling therefrom. It shall be the duty of every person in charge, possession or control of any cart or vehicle used for the purposes mentioned in this and the last preceding section to replace at once on such cart or vehicle any part of the contents thereof which shall or may have fallen, dropped or been spilled from such cart or vehicle or from any box or receptacle conveyed thereon, upon any street, public way or other place.

No person or corporation shall pile or deposit or cause to be piled or deposited any manure, offal, garbage or any accumulation of any offensive or nauseous substance anywhere within the city except at such place as may be authorized by the commissioner of public works in

and by a written permit issued for such purpose; and no person or corporation shall permit or allow any cart or other receptacle in his or its possession, charge or control, and which is loaded with any such substance, to remain or stand upon or along any railroad, street or public way within the city, within 300 feet of any building, structure or premises occupied or used for residence purposes.

No person or corporation shall place or cause to be placed upon any street, sidewalk or public way, or upon the roof of any building, or upon the surface of any lot or parcel of ground, any straw, hay, shavings or other substance which has been used as bedding for animals, for the purpose of drying such substance or storing same; nor shall any person or corporation burn or cause to be burned any such straw, hay, shavings or other substance which has been used as bedding for animals, in any place other than a properly constructed crematory, and then only upon a permit issued in writing by the commissioner of health for that purpose.

All stable manure, kitchen offal, garbage or other offensive or nauseous substance or material may be loaded upon railroad cars for immediate transportation from the city, at such place or places only as shall be designated by the commissioner of health; provided, however, that no place or places so designated shall be a nearer distance to any building occupied as a dwelling than 300 feet. No person or corporation shall use or occupy any place or places for the receipt, loading or dumping of such manure, offal, garbage or any other offensive or nauseous substance or material for immediate transportation without first obtaining a written permit for such purpose from the commissioner of health. Any person or corporation who shall violate any provision of this section shall, upon conviction, be subject to a penalty of not less than $25 nor more than $100.

Every person or corporation owning or controlling any hotel, restaurant, cafe, oyster house, saloon or other premises where more than twenty guests or boarders are fed daily, shall cause all offal, table refuse, shells and animal or vegetable matter commonly known and described as garbage, to be placed in proper metallic cans, which shall be practically air and water tight, and shall cause all such substances deposited in such cans or receptacles to be removed daily from his or its premises premises and to be disposed of either by burning in a properly constructed crematory, which shall have been approved by the commissioner of health, or by dumping the same at any dumping ground or place where garbage is dumped or disposed of by the city. The removal and disposition of such substances shall be done by such person or corporation at his or its own expense solely, and in accordance with the provisions of this ordinance and the directions or rules of the commissioner of health relating to the disposition and removal of such substances.

Any person or corporation who shall violate any of the provisions of this section or any rule or regulation prescribed by the commissioner of health in relation to the removal or disposition of the substances mentioned in this section shall be fined not less than $10 nor more than $200 for each offense.

Any person or corporation who shall violate, refuse or neglect to comply with any of the provisions of this article or any rule or regulation of the department of health made for the purpose of carrying into effect the provisions or any of the provisions of this article, shall be fined not less than $10 nor more than $200 for each offense.

No part of the contents of or substances from any sink, privy or cesspool, nor any manure, ashes, garbage, offal, rubbish, dirt, nor any refuse or waste or thing which by its decomposition could or would become offensive to human beings or detrimental to health, or create or tend to create a nuisance, shall be by any person thrown, deposited or placed upon any vacant lot of land or vacant place upon the surface of any lot of land within the city, whether such lot be inclosed or otherwise; nor shall any of said substances be allowed by any person to run or drop from the premises occupied by such person, upon any vacant lot of land or vacant place upon the surface of any lot of land in said city.

Asphalt Pipe Joints.

In a recent number of the London "Surveyor" Frank R. Durham has a communication giving a description of early successful work in jointing sewer pipes with asphalt, which will be of interest in this country. The communication is as follows:

The first engineer who adopted asphalt for jointing sewer pipes was Mr. W. H. Lindley, of Frankfort-on-the-Main, in the city of Elberfeld. The description of the methods he used was published in No. 2 of the "Thonindustrie Zeitung" of 1896. The following translated extract from this paper may be of interest:

The peculiar soil in which the sewer pipes had to be laid made the choice of a suitable jointing material a matter of consideration. The pipes had to be laid in a very porous loose, gravel, free of sand and earth. The subsoil water rises exceedingly quickly and to a great height during the flood times in the river. Moreover, owing to the ground levels of the locality, most of the sewers had to be laid at a considerable depth below the subsoil water level in order to obtain proper drainage. A clay and gasket yarn joint was altogether unsuitable; a cement joint was not advisable owing to the difficulties of obtaining a properly set joint while pumping off the water, and especially on account of the rigidity acquired by the pipe sewer and the difficulty of inserting an additional junction piece after the sewers were laid. Stanford's well-known patent joint was considered; it was rejected on account of expense and the necessity of special pipes with extra large sockets having to be used. A trial was then made of using asphalt, consisting of two parts by weight of liquid Trinidad goudron and one part by weight of "Vorwohler" asphalt melted in an ordinary tar boiler. The pipes were first correctly laid in position in the trench, and the sockets packed with tarred gaskets to about a third of the depth. On the spigot end, against the face of the socket was placed a thick India-rubber ring, held in position by a steel band with screws, and leaving a space at the top for pouring in the asphalt. This ring received a clay roll backing, as is used in making a lead joint for cast-iron pipes. The India-rubber ring was well greased in order to prevent the asphalt

adhering to it. The ring was removed as soon as the asphalt had set, which has been proved by experience to take about half to one minute. As a first practical trial a long line of sewer was laid, connected at the lower end to a manhole and closed with a water-tight cover at the upper end. The subsoil water was then allowed to rise and the pipe line at once began to float, affording a practical proof of the water-tightness of the joints. This method of jointing, requiring no specially formed pipes or patent sockets, has proved cheap and eminently efficient. The cost of the materials, including the preparation and the heating materials for the tar boiler, was as follows:

Diameter of pipe in inches.	6 in.	8 in.	10 in.	12 in.	14 in.	16 in.
Weight of asphalt mixture in pounds per socket	2.00	2.50	3.30	4.30	5.70	7.90
Weight of tarred gasket in pounds per socket	0.27	0.31	0.38	0.45	0.58	0.67
Total cost of materials per socket in pence	2¾	3¼	4¼	5¼	5¾	9

Since the success of these trials I may say that there are few towns in Germany that have not adopted this method, and in Austria and Russia many towns have followed Germany's example. The India-rubber ring above mentioned has now been replaced by cheaper special cork rings, or rings made of a thick piece of cord wrapped around with sacking; and asphalt mixtures can be obtained from nearly all the asphalt and tar factories. Not only has this method been adopted for the main sewers and for sealing the temporary covers for house drainage connections, but it has also been now prescribed in the house drainage by-laws of the cities where it is in use as the best and most efficient jointing for stoneware house drainage pipes.

I, myself, in my twelve years' continental experience, have laid many miles of such sewers and house drains, and can warmly recommend the use of this method of jointing. There are no such disadvantages arising from the contraction of this jointing material (leaky joints) as suggested by Mr. Ewing, and it has the following great advantages: The elastic joint does away with the antiquated rigid cement jointing with its concrete bedding still prescribed in this country; water-tightness; impenetrability against roots; simplicity of its construction, even in wet ground; the ease with which a junction piece can at any time be inserted in an existing sewer, the asphalt being merely run out by means of a brazing lamp; and, lastly, the automatic warning which the hot asphalt itself gives in case of an imperfectly run joint. Nor is there any necessity of patent sockets or similar devices, the ordinary bell-shaped socket being sufficient.

The Tankage of Sewage.*

By F. Wallis Stoddart.

The inspection and comparison of a large number of sewage works, all based more or less completely on biological principles, has brought into prominence the fact that there is an imperfectly understood difference in the final results obtained in different places under apparently identical conditions.

Putting aside, however, the comparatively limited number of examples in which the predominance of trade wastes or other local circumstances causes the sewage to depart appreciably from the normal, there remain abundant instances of works quite similar in construction and dealing with sewage of purely domestic type under apparently parallel conditions, where the general effect, including in this term both demand for supervision and perfection of final effluent, is by no means uniformly satisfactory, the chief cause of complaint being the production of offensive odors. On carefully tabulating these instances and comparing them detail by detail, it becomes quite unmistakably evident that the most variable factor is the length of time occupied by the treatment and the degree of putridity attained by the sewage before arriving at the final stage of oxidation.

It is further noticeable that the acuteness of the trouble is in direct proportion to the completeness of putrefaction, and that in cases where the detention of the sewage is exceptionally prolonged there is a very abundant production of offensive gases, the effect of filtration is but slight, and the interior of the filter, of whatever type, when dismantled, is found to be occupied to a large extent by a black slime, which coats the particles of medium with a tenacious and offensive layer, or even fills up the interstices altogether.

The following are typical examples: (1) A well-managed precipitation tank followed by a continuous or intermittent filter, giving an inoffensive effluent, and the clinker remaining sweet and clean; (2) contact-beds; no nuisance arising when the duration of stay of the sewage was eight hours, but a serious nuisance arising when the sewage was held up for the greater part of the twenty-four hours; (3) a septic tank of capacity about equal to one day's flow, the general effect being that the tank effluent produced is distinctly more offensive than the ordinary sewage, the quantity of tank effluent capable of being treated per unit of filter capacity being less than with a good precipitation effluent, and slime being deposited in a filter following such a tank; (4) septic tanks of much greater capacity than one day's flow; he quoted an instance where, with a dry-weather flow of

*A paper before the Royal Institute of Public Health.

3,000 gallons, storage capacity of about 14,000 gallons was demanded and provided, with the result that the whole contents of the tank were black as ink, the offense to the neighborhood was intolerable and the filter was heavily loaded with black silt, which deposited in all the channels and had to be removed where it could be reached.

The septic tank is credited with the destruction of the separated solids by encouraging their digestion by bacteria, and with appropriate preparations of the liquid product for the process of oxidation, also by means of obscure changes brought about by micro-organisms. Both objects are effected by retardation of the rate of flow in order to afford time for the necessary changes to take place.

Tank Capacity. — Numerous examples show plainly that there is considerable uncertainty as to the best tank capacity, but it is probably correct to say that in general it is considered that the provision of 1 cubic foot for every 6¼ gallons of the dry weather discharge per day of twenty-four hours represents the most advantageous arrangement, affording storage to allow of the sufficient deposition and resolution of solids without demanding too great an expenditure; but it is also evident that there is a feeling in many quarters that any departure from this should be in the direction of greater capacity, and that where expense is no object the size of the tank may be advantageously increased. This tendency arises from the very general assumptions, first, that certain ill-defined changes in the sewage as a whole are desirable, if not necessary, before oxidation; and, secondly, that the longer the sewage is delayed in the tank the greater will be the destruction of deposited solids, and the smaller will be the amount of sludge to be ultimately disposed of. These assumptions are so plausible, and supported by so much authority, that their acceptance, shared until lately by the author, is hardly a matter of surprise.

The opinion that sewage as a whole requires septic treatment as a preliminary step to oxidation has been chiefly advanced by theoretical writers, and is apparently supported by the analogy of natural deposits of putrefactive maters. But a reference to the history of the modern sewage filter will show at once that the whole of the experimental work upon which it is based was carried out with perfectly fresh sewage.

The work of the First Royal Commission on Rivers' Pollution (1870), in the course of which the commissioners evolved the intermittent filter; that of the author (1884-1893), by which the possibility of continuous filtration was demonstrated; of the Colonel Ducat (1898), and of the Massachusetts Board of Health and other investigators, was all carried out with fresh sewage.

It is evident, then, that so far as the production of a satisfactory final effluent is concerned there is no need whatever to effect any preliminary change in the liquid portion—that is to say, in 999 parts out of every 1,000 of the sewage. Its detention possesses the disadvantage of producing bodies which are not only the cause of offensive odors, but also prejudice the action of the oxidizing portion of the plant to a very serious extent.

The assumption that the more complete the destruction of the sewage solids the smaller must be the amount of sludge to be ultimately dealt with is wholly incorrect.

This became evident as soon as the progress of the experiments about to be described led to the subdivision of the tank.

This tank is divided into compartments by submerged walls and is fitted with boards, one function of which is to direct the flow of sewage downward, so as to insure the absence of any direct current from inlet to outlet.

Now, if the sludge consisted only of the residue of original solids it would naturally accumulate first in the compartment nearest the inlet and progressively in the later compartments as the earlier ones became filled. But this is not the case when this tank is worked at the orthodox rate of 6¼ gallons per day per cubic foot. It is then found, after some weeks, when the septic action is well established, and the normal formation of scum has taken place, that there is as much or more deposit in the last compartment as in the intermediate ones, though these are not full. Further, the character of the deposit varies in the compartments, for whereas that at the inlet end of the tank is a pasty mass of sewage solids more or less broken down, that at the outlet end is a black unctuous silt, characterized by the presence of a large proportion of ferrous sulphide—in fact, the identical material already alluded to as collecting in that portion of the plant which follows the tank when the latter is underworked. It is a direct chemical precipitation brought about by interaction between the iron and other bases present in all sewages, and the soluble sulphides and carbonates produced in the course of putrefactive change. The constitution of this material is, of course, not constant, but the following analysis fairly represents its composition: Water, 77.30 per cent.; volatile and or-

ganic solids, 5.15 per cent.; fixed mineral solids, 17.55 per cent.

Of the solids from 4 to 5 per cent. consists of ferrous sulphide, a substance which, when slowly precipitated, is associated with combined water, forming a bulky and tenacious gelatinous mass. Its other prominent features in the present connection are its black color, its avidity for oxygen, its resistance to bacterial disintegration and its tendency to evolve sulphuretted hydrogen on exposure. On microscopical examination no forms of life other than bacteria are observable. A marked difference between this deposit and ordinary sludge is seen in their respective resistance to bacterial attack. If a tank such as that described be sludged up at the usual rate of flow, and then allowed to rest, the deposit of sewage solids in the first compartments will practically disappear in about six months, while that in the last will be but little reduced, except as the effect of mere subsidence.

Secondary Deposits.—One more serious practical difficulty in sewage treatment directly traceable to the same cause—namely, over-putrefaction—is the formation of a thick blanket growth on the surface of the filter. This growth, which, for want of a better explanation, has often been stated to be connected with the mode of application of the liquid to the filter, is really due to the presence of sulphuretted hydrogen in the tank effluent. It consists of various species of sulphur bacteria which can only flourish in a situation where both sulphuretted hydrogen and air are present. The surface of a sewage filter fed with normal septic effluent, always charged with sulphides, is an ideal locality for these organisms, and they take advantage of it to an extent which may seriously interfere with the efficiency of the filter.

Precisely the serious phenomena described may often be observed where sewage is discharged into running water. Immediately adjacent to the outfall there is a deposit of sewage solids and a luxuriant growth of sewage fungus, but no marked discoloration or offensive odor. Further down stream, and often separated from the outfall by a perceptible interval, the black deposits and offensive odors popularly attributed to the sewage itself, but really due to the products of its decomposition, are to be observed. It follows that under the usual conditions of work the destruction of original sewage solids in the septic tank is largely counterbalanced by new formations. If it were not for the constant discharge of appreciable quantities of this secondary deposit at the outlet of the tank, this phenomenon would have attracted greater attention, while the general absence of baffle walls has further disguised the local deposit by allowing the sludge to assume a fairly uniform level on the floor.

But the consequences of allowing these secondary bodies to form are still more disastrous. If any filter attached to a septic tank be dismantled it will be found that the pieces of medium are coated with a layer of black slime several millimetres in thickness, the surface, under favorable circumstances, being of a brown-red color, owing to the superficial oxidation of the ferrous sulphide, to which the black tint of the slime is due. Not only, therefore, is the aeration of the filter mechanically diminished, but the medium is coated with a material having an immense appetite for oxygen, and directly antagonistic to the function of the filter as an oxidizing agent.

A consideration of these facts naturally led up to a series of experiments having for their object a determination of the conditions of working which allow of the most complete destruction of original sewage solids, with a minimum formation of the offensive and otherwise objectionable secondary products; or, reverting to the illustration of the polluted stream just given, to ascertain whether it would not be possible to adjust the plant so that the filter might be placed at the "perceptible interval," and so anticipate the development of offense by putting an end at once to the possibility of putrefaction in the sewage already denuded of its suspended solids. It was considered desirable at the same time to consider what modification of internal structure would best promote the retention of solids of all kinds at the inlet end of the tank, so as to prevent their escape on the filter, and what is the best method of dealing with the residue. These various points were, of course, attacked more or less simultaneously, but it will add to the clearness of the following summary if they are now treated separately.

The tanks employed were open to the air and measured 19 ft. 2 in. by 6 ft. 11 in. by 6 ft. deep, having a net capacity of 4,910 gallons.

The arrangement of subdividing the tank by submerged walls and scum boards was retained, but the dimensions of the partitions of both kinds underwent considerable change in the course of the experiments.

The following arrangement was found to give the most useful results: Each tank is divided into four compartments by three dwarf walls placed at equal distances apart. The first wall is brought

up to an inch from the surface, and the first compartment therefore forms a sumph, which can be dealt with in any desired way without disturbing the rest of the tank. The remaining walls rise to 1 ft. from the surface. All the scum boards, except that connected with the outlet of the tank, dip 2 ft. into the liquid, and therefore overlap the walls by 1 ft. They are placed vertically midway between the walls. The withdrawal of the tank effluent is by means of a plain sill, protected by an obliquely placed scum board. The whole arrangement has been given an extended trial, and the tanks so equipped have worked more uniformly and successfully than any other modification.

Rate of Flow through Tank.—If the sewage were delivered at a uniform rate throughout the twenty-four hours it would be a comparatively easy matter to determine the definite rate at which the best results were obtained, and to fix the tank capacity in accordance therewith. In actual practice it is necessary to make a considerable allowance for natural variations, due partly to variable rate of production, partly to increase by storm water, some, at least, of which it is generally agreed, should be submitted to tank treatment; and there seems to be no good reason for departure from the practice, based on the regulations of the local government board of fixing the limit quantity to be so treated at three times the normal dry-weather flow.

It appeared, then, that the most direct way to attack this part of the problem would be to carry out two series of experiments—a preliminary series, in each of which a constant flow of full-strength dry-weather sewage would be maintained for a prolonged period, and a second series, in which the maximum rate so determined as satisfactory would be adopted as the maximum three-fold flow, but in which the actual rate of flow would follow the natural variations, the tank capacity being so adjusted that the average dry-weather flow would be one-third this maximum.

These experiments, like those which led to the elaboration of the continuous sewage filter, were carried out with that treated at the Horfield works at Bristol. The quantity of dry-weather sewage averages almost exactly 15 gallons per head of population; and partly in consequence of this low figure, partly because a large proportion is derived from the Horfield barracks, the strength in organic constituents is, as has been attested by numerous independent observers, very much above—more than twice—that of average domestic sewage.

It was established in the experiments on filtration that the proper maximum rate of application to the continuous filter of the Horfield dry-weather sewage after tanking is 300 gallons per cubic yard per twenty-four hours; if the experimental tanks produced a liquid capable of yielding a filtrate of equal merit at the same rate, and possessing the necessary physical recommendations, they were held to be working satisfactorily.

Reverting to the first series of experiments, that in which the tanks were fed a constant rate over prolonged periods with dry-weather sewage, it was found that excellent results were obtained up to a rate of flow corresponding to three tank capacities a day, or to 20 gallons per day per cubic foot of tank capacity. At 30 to 35 gallons per cubic foot (five to six capacities) the filtrate began to deteriorate, as shown by the appearance in the filtrate of the persistent opalescent characteristic of sewage and tank effluent, while at 56 gallons (nine capacities) the filtrate was hardly distinguishable in appearance from tank effluent, although there was still a fairly strong nitrification. This opalescence is perhaps the most valuable of the rapid tests for final effluent, as its appearance invariably indicates the approaching break-down of the filter. The rate of flow on the filter being, of course, maintained at the same rate throughout, the appearance of the filtrate was plainly due to the excess of finely divided solids, amounting at this time to 54.5 parts per 100,000, brought forward by the rapid flow through the tank.

At this point an interesting observation was made as to whether the continuous filter would deal with this inferior tank effluent at a reduced rate.

On cutting the flow down to 110 gallons per cubic yard, nitrification advanced quite normally, the nitric nitrogen in one experiment reaching 6.6 parts per 100,000; but the appearance of the filtrate was practically unchanged, and as the opalescence undoubtedly implies the presence of much organic oxidizable matter, the value of high nitrate was heavily discounted, and it was therefore decided that extension of filter area would not compensate for insufficient tank accommodation.

At all rates of flow, from 12 gallons per cubic foot upward, the tank effluent was inoffensive. There was a complete absence of the bacterial scum, the formation of which is a source of so much trouble to both tank and filter.

It was concluded from the first series of experiments that the best constant rate of flow—that is to say, the most rapid

uniform rate at which full-strength sewage could be passed through the tank with most satisfactory results as regards both destruction of sewage solids and quality of tank effluent—is insured by providing a tank capacity equal to one-third the day's supply of sewage, or 1 cubic foot for 20 gallons, and that the extreme limits between which satisfactory results can be obtained are 12 and 35 gallons per cubic foot, respectively.

The most promising conditions for the second series of experiments were thus made extremely clear. For if it is desired to treat in the tank quantities of sewage up to three times the average dry-weather flow, and the maximum amount the tank is capable of treating is 35 gallons per cubic foot (six capacities), it is evident that the dimensions of the tank should be such as to provide 1 cubic foot for each 12 gallons of dry-weather sewage (two capacities), or in other words, that the tank should be capable of holding half the average dry-weather daily flow. In this way the normal increase of about 50 per cent. which occurs during the busy hours of the day will bring the rate of flow to the most favorable state—namely, 20 gallons per cubic foot; and in times of rain the tank will still be able to deal with an additional 15 or 20 gallons per foot, which will only bring the rate to the maximum the tank will deal with on the assumption the sewage is of full-strength and not diluted. The chief danger appears to lie in the possibility of too much stagnation during the night, when, of course, the rate is much diminished.

Accordingly, the capacity of the tank being practically 5,000 gallons, arrangements were made by which a portion of the crude sewage, corresponding in all respects as regards composition and rate of flow to the main supply, and varying in amount from 10,000 gallons per day in dry weather to 30,000 gallons when sufficient was entering the works, was admitted.

This experiment was started on November 18, 1904, and has continued without cessation. The effect has been exactly what was desired. The tank effluent has always been inoffensive and sufficiently free from suspended soils; and these last consist of light brown flocculent matter entirely devoid of the black, slimy silt characteristic of the septic tank effluent. On the near side of the first scum board is a thick floating mass of paper, match sticks and the life forms, but there is little or no true bacterial scum even there, while the latter parts of the tanks are destitute of scum of any kind. The only particular in which the results have differed from those obtained when the tank was worked under uniform flow is that at the maximum rate of 35 to 40 gallons per cube foot when maintained for days at a time by heavy rainfall, as in the first two weeks of March, a much better tank effluent was obtained than with full-strength sewage, and it was evident that this upper limit might be extended for dilute sewage if desired.

The suspended solids in the tank effluent have varied from 8 to 20 parts per 100,000, but are fairly uniform at about 14 parts. Hourly samples collected throughout June 29, when the conditions had been normal for some time, and mixed in the proportion of the flow, gave 96 parts in the sewage, 14 in the new tank and 16 in the precipitation tank.

Each month the first compartment has been filled to an average depth of 3 ft. 6 in., and therefore contained 125 cubic feet. The composition of the sludge on the average is as follows: Water, 91.72 per cent.; volatile and organic, 4.48 per cent.; mineral, 3.80 per cent. The month's accumulation of dry solid matter from 300,000 gallons of sewage amounts therefore to about 6 cwt.

There is a good deal of difference of opinion expressed as to the amount of sewage solids actually destroyed in the septic tank, but it probably seldom, if ever, exceeds 50 per cent. of those introduced with the sewage, and is generally put at from 30 to 40 per cent.

In the present instance, making a liberal allowance for solids carried over with the tank effluent, the proportion which disappears must exceed 50 per cent. The modifications in the construction and use of the tank now suggested succeed, therefore, in abolishing the most serious drawbacks of the septic tank without relinquishing any of its advantages in respect of the easy and economical destruction of solids. But in order to secure these advantages it is plainly necessary to acquire a fairly accurate knowledge of the average amount of sewage to be dealt with, and nothing is more astonishing in connection with schemes of sewage disposal than the general absence of information as to the volume of sewage dealt with, even in existing works.

Sludge Disposal.—As has already been stated, the accumulation of sludge, even at the more rapid rates of flow, was surprisingly slow, showing that the resolution of sewage solids proceeds much faster than has hitherto been suspected, and is quite independent of the formation of a thick bacterial scum and the other unpleasant evidences of over-putrefaction.

The sludge formed under the conditions laid down is less stable than that formed

under prolonged bacterial action, and, further, is not mixed with the secondary deposits, which are little, if at all, amenable to this action. Such a deposit, then, if left to itself, will very materially diminish, and a very considerable destruction of solids can be effected in this way without expense or offense.

But an obvious objection to allowing the tank to sludge up is that it alters the capacity of the tank.

The best way to remove the sludge from tanks of the type described is to lift it out by means of a chain pump. Sludge channels into outside sumps are not satisfactory, because the sludge becomes compacted and the supernatant water bores through it and escapes.

The intervals that may elapse between successive removals of sludge will vary with the character of the sewage, but this is not likely to be necessary at shorter intervals than at Horfield, where the removal takes place once a month.

To dispose of the sludge a plot of ground 32 ft. square has been trenched, and suffices for three applications; the sludge, however, drains rapidly and leaves such a small actual residue that the same trenches could be used more frequently. The sludge produced is quite inoffensive, and yet is naturally of high manurial value, containing, when air-dried, about 2 per cent. of nitrogen and phosphoric acid, equivalent to 1 per cent. of tricalcic phosphate.

As already stated, the tank which forms the subject of this paper, commenced work on November 18, 1904. A few inches of sludge soon appeared in the second compartment, being carried over from the first at times of heavy flow, but the third and fourth remain entirely free from sludge.

A Pooling Agreement Illegal and Void.

A pooling agreement between two contractors has come to grief in the United States Circuit Court for the Western District of Pennsylvania (139 Fed. Rep. 780). The War Department ordered the Jones & Laughlin Steel Co. to remove a quantity of slag it had dumped into the Monongahela river, and so the company asked two dredging contractors to bid on the work. They promptly put their heads together and tendered $1.60 and $1.70 per cubic yard for the work, although it was eventually done at a cost to the contractors of 9 cents. The two contractors agreed that each was to do half the work, no matter to which party the award was made. The Jones & Laughlin people considered these prices too high and rejected both bids. Subsequently the United States engineer officer modified the requirements for the work and a tender of $1.25 from one of the contractors was accepted in accordance with which the slag was removed and payment made for the dredging. The other contractor thereupon brought suit for an accounting in accordance with the agreement. The court refuses to entertain such a suit on the ground that the agreement was a conspiracy to defraud the steel company, and as such was illegal and void. "Viewed from the standpoint of morals, square dealing and commercial integrity, combinations for collusive, misleading biddings, wherever made, can not be approved."

WATER AND GAS

High Pressure Water Supplies—Formation of Anchor Ice—Municipal Gas.

High-Pressure Water Supplies for Fire Purposes.

The following points from a report of a committee of the National Fire Protection Association are of special interest to water-works superintendents and engineers:

Stationary pumping plants in large units, under ample power and with well-trained operating force, are not subject to the many adverse influences that affect the individual fire engine and can deliver supply both in quantity and force unattainable by any other practicable means.

Quantity and force of delivery are essential to cope with extreme conditions. Whether the numerous powerful streams that can be derived from high-pressure systems such as have been recently designed will be sufficient to check a conflagration when once well under way is not claimed, but it is indisputable that the force at the disposal of a fire department will be largely augmented and may be concentrated to better purpose.

The term "high pressure" here applied

is in contradistinction to a low-pressure service such is adequate for efficient hose-stream purposes. This "high pressure" might be spoken of as "adequate pressure" or "adequate direct pressure," meaning a sufficient pressure for fire streams when directly connected to hydrants without the intervention of steam fire engines.

A high-pressure fire system must at all times be capable of furnishing a supply of water adequate, both in volume and pressure, for the local needs and uses.

Where such a system is to be specified, its proper uses (outlets) will be found to be much the same for all cities, and the pressure necessary will not vary greatly, but the quantity of water advisable and the water supplies available will be found to differ materially.

Water Outlets and Pressures.—In the consideration of this subject we will start in at the point where the water is discharged, in order that we may determine the pressure and volume required and thereby suggest the hydrants, piping and water supplies necessary.

A water system for fire extinguishment, to be comprehensive, should be capable of feeding all of the following services:

1. Inside hose streams, as connected with standpipes or brought into building by a fire department, for which 25 pounds minimum nozzle pressure is desired. It is to be noted these streams are subject to intermittent use, as by the operation of a shut-off nozzle.

For the 25-pound minimum nozzle pressure inside standpipe stream, 100 pounds at the high-pressure street main would provide for the stories of buildings up to 100 ft. in height. An ability to increase this street pressure to 200 pounds would take care of the interior standpipe service for a fire in the building in which the standpipe was located in all structures likely to be erected.

2. Automatic sprinkler systems, as used in the interior of numerous buildings, and destined to be much more generally employed in the future, are the most efficient known means of fire extinguishment. These systems require for fully satisfactory service not less than 25 pounds pressure at highest sprinkler level, and the approved makes, together with the piping and valves of the system, are safe under 300 pounds pressure. It will therefore be seen that pressures which properly serve the above-noted inside hose stream service will be adequate for automatic sprinkler systems.

We recommend that automatic sprinkler systems be regarded as among the proper outlets for a high-pressure fire system; that a permanent metal pipe connection for automatic constant service should be allowed from the street main to well-installed and maintained sprinkler equipments; that pipe of 4-in. size is adequate for giving the initial pressure and service, pending the arrival of the fire department.

3. Outside hose streams—namely, those directed on a fire from without the building in which it is burning.

The loss of pressure due to friction in fire hose is, as a rule, not properly appreciated, and frequently the complaints as to lack of water supply should be more properly lodged against the necessity of using long hose lines. For all such high-pressure services effort should be made to diminish this trouble by very frequently located hydrants and by hose of larger diameter than the 2½-inch now most commonly used for fire streams. Three-inch diameter hose should be the minimum and may be regarded as reasonably satisfactory for this service. It is now used in a number of our large cities and proves satisfactory under heavy pressure, rough usage and long periods of service. Even larger diameter hose, namely, 3½-inch, is in use on the high pressure service system in Philadelphia.

We find no objection raised to 1¼-inch diameter, smooth-bore nozzles as especially well adapted for ordinary inside and outside department streams, but it is generally admitted that, with fires of any consequence, a considerable number of larger diameter streams should be promptly employed, for which purpose 2-inch diameter nozzles are here recommended. The latter, under 75 pounds nozzle pressure, will discharge approximately 1,000 gallons per minute.

In actual practice, an average of about one-third more hose is laid out in a stream than required to reach from the hydrant to the nozzle location if measured in a direct line. With hydrants located with reasonable proximity, this will mean that hose lines varying in length from 100 to 400 feet will need to be employed, and we must provide pressures sufficient to overcome the friction loss under the most severe conditions, namely-in 400 foot hose.

Outside hose stream service is divided into the following four classes:

(*a*) Hand-held Portable Streams Operated from the Ground.—Seventy-five pounds pressure at the nozzle is about as high as is feasible and allow the control, direction and moving about of such streams while in service, even if in the hands of a well-trained squad of firemen. To provide for this class we must be able to maintain pressures at the hydrants varying, let us say, from 100 to 175 pounds.

(*b*) Machine-held Semi-portable Streams Discharged from the Ground.—There are

now various devices for relieving the recoil at the free end of the hose stream and making it easy and comparatively safe for one or more men to care for the nozzle. With some of them, a moderate increase of service pressure over that obtained with ordinary hand-held stream is feasible, and with others, there is no practical limit to the increased pressure which can be safely handled.

We believe, however, that a 2-inch nozzle discharge under 75 pounds nozzle pressure possesses the qualities necessary for effective service from the ground, and that no higher pressures are advisable for this type of service, even if buildings are unusually high, as increased pressure would not materially better the penetration of such a stream within stories at a high level. The angle of discharge from ground streams renders them of comparatively little service above the fourth or fifth stories of average buildings.

(*c*) Semi-portable Streams from Department Water Towers.—These excellent devices which raise the nozzle from the ground the equivalent of three or four stories bring said stories into the realm of service of an outside stream, and for this purpose the pressures required must be increased some 25 to 40 pounds to overcome the head from this higher elevation at which the tower nozzle is discharged and the friction in the apparatus.

(*d*) Streams from Metal Standpipes and Roof Hydrants on Nearby Buildings.—We regard this class of service as offering excellent opportunities, and would advise that street fronts of buildings in congested city districts at intervals not exceeding 100 feet be fitted with 6-inch standpipes with metal ladders attached.

This class of service requires high pressure due to height of buildings as at present erected. There is, however, some reasonable limit in height of buildings beyond which it should not be required to extend the public fire service, thereby taxing all for the excessive wants of a few. These latter should provide their own fire protection, build and occupy so as to be non-combustible, or, where the building laws are lax enough to permit such conditions, go without protection and perhaps without insurance. Such buildings are at present infrequently located, and the burning out of the tops of such pinnacles should not seriously menace lower surrounding buildings.

We could, therefore, consider 100 feet above grade as a fair limit of height for full service of a high pressure system. This limit would require, using round figures, a maximum of 225 pounds pressure at hydrant, viz., 75 pounds for nozzle pressure, 100 pounds for friction loss in hose and pipes and 44 pounds equivalent to the standpipe head.

(*e*) Exposure Sprinklers Commonly Known as Open Sprinklers.—Systems fitted with these sprinklers are now being developed to an efficient state where ample water supply and pressure can be found with which to supply them. Our proposed high pressure fire service systems would constitute an ideal water supply for them and would be connected up to a siamese inlet as above described for the standpipes.

So far as pressure is concerned, that which would be adequate for the standpipe service would properly serve the exposure sprinklers.

To properly supply the several services, pressures must be maintained at the hydrants as follows (using round figures):

Inside hose streams, 1¼-inch nozzle, 400 feet 2½-inch good hose, 25 pounds nozzle pressure, 75 pounds.

Inside standpipe streams (two in use) through two 400-foot siamesed lines, 3-inch hose, 100-foot 6-inch vertical pipe, 100 feet 2½-inch hose, 25 pounds nozzle pressure, 1¼-inch nozzle, 100 pounds.

Automatic sprinkler system, two 400-foot lines, 3-inch hose, 100 feet vertical 6-inch pipe, 200 feet horizontal 6-inch pipe, 25 pounds maintained flowing 1,000 gallons per minute, 160 pounds.

Ground hose streams, 75 pounds nozzle pressure, 2-inch nozzle, two 400-foot siamesed 3-inch hose lines, 175 pounds; 1¼-inch nozzle, 75 pounds nozzle pressure, 400 feet 3-inch hose, 140 pounds.

Standpipe stream, 2-inch diameter universal nozzle attached to top of 6-inch standpipe 100 feet above ground, 75 pounds nozzle pressure maintained, two 400-foot siamesed 3-inch hose lines, 225 pounds; two streams attached to roof hydrant on 6-inch vertical pipe 100 feet above ground, 1¼-inch nozzles, 2½-inch hose, each line 100 feet, 75 pounds maintained at nozzles, the standpipe fed through two 400-foot siamesed 3-inch hose lines, 225 pounds.

Water Supply.—We have above indicated the water pressures necessary for efficient fire fighting, and will now refer to the amount of water which should be provided, capable of all being discharged at not less than the pressures above specified.

We would first call attention to a feature we note in water works or other reports as to the amount of water consumed for fire purposes. It is customary in water works phraseology to speak of the discharge per 24 hours. Few fires last so long a time. It is necessary that sufficient water be supplied to feed all the outlets put in service at one time, and we will here speak of the quantity desired

per minute, the unit employed by the fire protection engineer.

In fighting city fires there are two situations to be taken into consideration—the local fire and the conflagration. The former is represented by a fire in one building or a few contiguous properties either in one block or on opposite sides of alleys or streets. It is reasonable to direct efforts and provide apparatus and water supply with the intention of extinguishing such a fire. The amount of water to be provided for local fires will depend upon the area of the buildings, the occupancy, height, depth and construction, and also upon the barriers existing in the way of fire walls, wire, glass, shutters and exposure sprinkler protection at window openings, and on openings, and on open areas; in other words, upon the amount and location of the combustibles.

In providing quantity of water for a high pressure service under the least exacting conditions, we would recommend as a minimum for local fires some 18, 1¾-inch streams, or 7, 2-inch streams, which are equal to 7,500 gallons per minute discharge at the required pressures. For the most exacting local fire requirements, we should judge as adequate discharge under the conditions named of 20,000 gallons per minute, which is the equivalent of 50 1¼-inch streams, or 20 2-inch streams.

The second condition for which we have to provide is the fire which has spread beyond control and developed into what is termed a "conflagration." For this purquantities above specified from 50 to 100 pose, we advise a reserve increasing the per cent., conditioned upon the extent and nature of such conflagration district.

For how long a period shall water be furnished to these outlets? Baltimore burned for the greater part of two days. Other historic conflagrations have been of longer duration. Where provision is to be made for a conflagration service, it would seem reasonable to indicate as a minimum available quantity of water an amount which would supply the service in its full efficiency for a period not less than 36 hours.

It is needless to report a gravity service, which fulfills the requirements here set forth, as most desirable. It will mean a service constantly maintaining a high pressure, but normally throttled by gate valves for the use of the first few hose streams which will control and extinguish the large majority of fires. Pumping plants with power from steam, electricity or gas are also practical for this purpose, the customary reasonable precautions being taken as to fireproofing of buildings, freedom from interruption of service, either in respect to power, pumps or water supply; and the use of multiple units so that a single break or state of repairs will have but little effect upon the whole. Where available, the providing of connections for use of sea water as a reserve supply is to be recommended and will doubtless frequently be availed of as providing complete assurance of a water supply without limit in event of adverse contingencies.

No unusual conditions are to be met in the distribution system, simply the use of the proper specifications for heavy pressure pipes, hydrants, hose, nozzles and holders, which are all now commercial realities. Special care must be exercised in the planning of the gridiron system, the use of properly laid pipe of suitable size so as not to cause a drop in pressure of any importance, due to friction loss while delivering at any point in the system the full amount of water there required under the pressure conditions specified. The well established practice is to be noted of placing gate valves where the gridiron crosses at all street intersections, that short lengths of piping not exceeding one block could be at any time cut out, leaving the rest of the system in complete service.

In view of the usefulness of these systems for "first streams" and the desire to keep them in operation for fire purposes at all times, it is advisable that they be not used for any other purposes, such as street flushing.

Once such a system is properly installed, its efficiency will largely depend upon its careful maintenance, checked up by organized tests and examinations, all of which should be gone into most carefully and reported upon frequently, using detailed report blanks for such purpose.

We suggest hydrants frequently enough located so that all of the water required at any one building can be there discharged without the use of hose lines longer than 400 feet. The hydrants to be used for this purpose should all be located within 250 to 300 feet of the building to be protected.

We suggest 100 feet above grade to be considered the maximum height for which full public fire service need be provided; that buildings exceeding this height be required to have non-flammable construction or occupancy, or equipped with automatic sprinklers and other fire appliances, provided by proper independent water supplies.

Maximum pressures in the street main necessary for such services vary from 100 pounds to 225 pounds, and must be provided for.

The required capacity of the water supplies at the pressures indicated should range according to conditions in individual cities from 7,500 gallons to 20,000 gal-

lons per minute for local fires, and 50 to 100 per cent. additional for conflagration fires; these quantities to be provided for not less than 36 hours' constant service.

We deem such systems practicable, of decided advantage for certain places and recommend their introduction.

The Formation of Anchor Ice, and Precise Temperature Measurements.*

By Dr. Howard T. Barnes, McGill University, Montreal, Canada.

My attention was first directed to this very important problem by the harbor commissioners of Montreal in 1896. The chief engineer of the harbor commissioners, Mr. Kennedy, was a member of the flood commission to investigate the very serious floods that visited the city of Montreal from time to time, and he was appointed with other gentlemen to go into this question with a view of alleviating the disastrous effects. During the investigation of the flood commission efforts were made to study the slush ice, which is called in Canada frazil ice, and to connect the formation of this remarkable ice with the temperature changes in the water. The commission took a series of measurements of the temperature of the water, and they thought they detected small differences of temperature during such times as the ice was most severe. But they were not sure of their results on account of the difficulties encountered in making the measurements. Thus the commission came to McGill for more refined measurements. They wished, if possible, to connect the temperature of the water with the formation of frazil ice.

We devised then an instrument for doing this, which depended on the change in the electrical resistance of platinum wire. Such instruments have been made before and have been exceedingly useful for all classes of temperature measurements; but we devised the most delicate differential thermometer that probably has ever been made. This thermometer had a degree which was 8 inches long. It was possible to estimate by this means to the ten-thousandth part of a degree.

The varied conditions in which we meet river ice make it almost impossible to establish a definite set of rules by which we can say how much ice will be formed or what the ice will do. The weather itself varies from year to year, and what conditions will hold one year will be entirely different the next. The problem is a problem of heat transmission. The extraction of heat from the water causes ice to form. How is this heat abstracted and how does water gain heat again?

The three recognized methods of transmission of heat are convection, conduction and radiation.

The first method, convection, we may briefly define as the transmission of heat by the movement of matter itself. It depends entirely on the fact that matter, when heated, expands and becomes less dense. We have one exception to this in water at 4 degrees Cent. At 4 degrees we have the maximum density or the liquid occupying the least volume. Below that point to zero water expands. Above that point, as high as we can go, water expands; hence we see that in the case of water the process of convection will cause a current of warmer water to rise until we get to 4 degrees, and then the reverse process will take place. Below 4 degrees, as the water becomes cool, the warmer layers sink to the bottom. That has a very important influence, as we shall see presently, in ice formation in lakes and quiet water.

I want to dwell for a short time on the physical properties of ice. We know that ice is very plastic; it can be molded into various shapes. We have examples of ice which has been pressed between heavy molds to form perfect spheres; and ice that is pressed in a cylinder may be forced out of a narrow opening. Ice, however, does not exhibit the characteristic properties of viscosity. The phenomenon which enables it to give under pressure is probably due to another physical property of ice—namely, regelation. We know that pressure sufficiently great will melt ice; 150 atmospheres pressure will lower the freezing point of water and ice 1 degree Cent. It does this by squeezing some of the ice back into water; the temperature is lowered by the melting of the ice and the absorption of the heat. Regelation accounts for a great many ice phenomena of nature. A very beautiful example of regelation is Bottomley's experiment. It is a block of ice being cut through by a wire attached to a weight. I dare say many of you have seen the experiment. The pressure of the wire at the point of contact melts the ice. The water runs around the wire and finds itself freed from the pressure and at a temperature lower than its freezing point; it freezes again above the wire. In this way the wire slowly creeps through the ice, leaving it as strong after the wire passes as it was before. By means of pressure we can freeze blocks of ice together—two pieces of ice brought together and pressed will stick together. A slight film of water is formed on the touching

*From a paper before the American Society of Mechanical Engineers.

surface and immediately the pressure is relieved the water in contact with the ice surface finds itself below the normal freezing temperature at once solidifies, cementing the two blocks together.

There is another property which ice possesses and which has quite recently been measured. That is, it possesses the power of growing by itself; ice in contact with water exactly at the freezing point apparently goes on growing. You have all observed the beautiful growth of a crystal of alum or a crystal of sugar in a saturated solution of the alum or sugar, and how it gradually increases in size. Apparently ice does the same thing, only very slowly. As I shall explain to you presently, water possesses ice in solution. The rate of growth of the ice crystals has been measured. If we allow the natural rate of growth to go on it would form an inch in about two and one-half years. So it does not form a very important factor in practical engineering problems. It forms an important factor, however, in this respect, that it helps to cement ice crystals together.

Below 40 degrees Cent. or about 97 degrees F. water commences to form ice; this ice remaining in the solution until the freezing point is reached. The proportion of ice increases as the temperature falls, and at the freezing point we have actually a saturated solution of ice and water. It explains to us the maximum density of water and the minimum specific heat.

The curve showing the variation of the specific heat of water drops very rapidly from 0 degree Cent. and passes through a minimum at 40 degrees. Now, that is apparently due to the fact that besides the heat absorbed in the natural expansion of the water we have the heat absorbed in transforming those ice molecules into water molecules. That is, as the temperature rises the amount of heat that would be absorved by the ice becomes less and less. At 40 degrees Cent. we have an exact balancing. From 40 degrees upward we have water existing as a pure liquid.

I think I have taken up the chief points in regard to the physical properties of ice and water, with the exception of the great change in volume that takes place when water freezes, which has such an important influence in river-ice formation. There is an increase of about 9 per cent. in volume, and this is exceedingly important inasmuch as the ice, as soon as it is formed, comes to the surface or remains on the surface. Take, for example, a sheet of quiet water which is cooled lower and lower by the advent of winter weather. The surface becomes cool; the cooler layers fall to the bottom until 4 degree is reached. Then the warmer layers stay at the bottom and the cooler layers remain on top. As soon as the surface gets to the freezing point ice forms. This ice spreads over the surface, usually from the banks toward the center, and gradually increases in thickness by conduction.

Let us consider what goes on in the case of a river which is flowing too rapidly to form a surface of ice. Naturally we will have instead of the flat surface ice, ice of finer quality formed. Each little piece of ice produced by the cooling of air on the surface is carried down by the currents and submerged, rising to the top again as the currents carry it above. Not forming the protecting layer of ice, the flowing river loses a very much greater amount of heat, and the fine ice is produced by agitation in very great quantities.

These fine crystals of ice which are formed, and which are called frazil crystals, are swept down with the current, and are carried by the current for long distances from open water under the surface ice. It was one of the discoveries of the flood commission of Montreal that this ice was found many miles below the bordage ice at the foot of the Lachine rapids, where the greater portion of this ice is formed. An inspection of the many diagrams of the flood commission for various sections of the St. Lawrence river below the city of Montreal shows immense accumulation of frazil. It was found on examining this ice that it was very spongy. In determining the depth of the ice a leaded weight could be lowered through by slight pressure from above, and it was found that this ice accumulated under the surface ice to depths ranging from 30 to 35 feet. That it acted as a filter to the water which penetrated it was shown by the accumulation of a great deal of matter from the water just as a sponge accumulates slime from water. The great bulk of this ice which they found was manufactured in the Lachine rapids and in the reaches of open water extending about six miles from the ice sheet on Lake St. Louis. They found in many places below the rapids that there was more ice than water. The percentage of this ice became less further and further below, until finally, some twelve miles below, the frazil was exceedingly scarce. In general, wherever an open river flows unprotected quantities of this frazil ice are formed by radiation and by convection of air currents and wind agitation. These crystals of ice vary in size, depending upon the agitation of the water. The more rapid the agitation the finer they are, and the further they travel the larger they grow.

There is another form of open-water

ice which we must consider, and which is primarily the subject of this paper—namely, anchor ice. Anchor ice and frazil ice are often mistaken for the same thing. As a matter of fact, we must draw a line between the two. Frazil ice is ice formed in the water itself by surface agitation and other causes. Anchor ice is ice that grows on the bed of the river, on the rocks, on anything in the bed of the river to which ice may be attached.

There is still a difference of opinion as to how this anchor ice grows, how it first forms, but I think when we consider the amount of heat which is lost from the surface of a river by radiation and the fact that much of this heat can penetrate through the water, that we must admit that radiation plays an important part. When we consider further that this anchor ice is formed only at night, when the radiation from the earth is a maximum, that as a rule it never grows under a bridge or under any object which would reflect the heat rays back again into the water, and when we consider that anchor ice apparently grows more rapidly on dark rocks than on light rocks, then we must admit there is strong suspart in its formation. That anchor ice is picion that radiation plays an important built up as well by the freezing to the bottom of frazil crystals goes without saying. It could not be otherwise. These surface currents carry down the fine pieces of ice, which, passing across the layer of anchor ice which may have formed there by radiation, become attached, and we have then great thicknesses built up in a single night. Anchor ice is formed partly by radiation and partly by the sticking to the bottom of these frazil crystals. Anchor ice, during a severe spell of weather, when it is cloudy by day and clear by night, attains a thickness of several feet, such that a pole or a stick placed on the ice will sink into it to considerable depth. When the sun rises it has been noted for a long time that these masses rise to the surface. The boatmen are very chary about going across an open channel when the sun is bright, for these masses come up in great quantities. As soon as the sun gets at a sufficient angle so that its rays penetrate the water they pass through the water and ice, warm the bed of the river and warm the water in contact with the ice. The ice rises with a characteristic hissing noise several feet above the water and then falls back, turning white as the water drain out of it. It floats low in the water because it is saturated and waterlogged just as sawdust will float lower in the water than an equal mass of solid wood. The fact that these anchor ice masses float lower in the water than a similar weight of packed ice would has given rise to the opinion that anchor ice was ice denser than normal and therefore held down by its own weight. There is no evidence whatever to show that ice of a greater density than normal exists, and we therefore disregard that idea as being entirely untenable. Ice at one particular density is formed, and only one. The reason of anchor ice being fastened to the bottom is that it is actually frozen there. As evidence of its buoyancy, large masses of rock are sometimes brought up with the anchor ice and carried down the river. Anchor ice will carry large boulders, which fill up the channel of the river, and that is one thing the Montreal harbor commissioners have to contend with in the harbor there. They have annually removed a large amount of rock and boulders carried down by the anchor ice. This anchor ice, when it comes up, becomes disintegrated and is carried down with the currents, thus aiding the frazil in causing the damming up of the channel.

Now, it was the problem set me by the harbor commissioners to determine, if possible, what were the relations between the temperature of the water, if any, and the formation of anchor ice on the bottom, and the peculiar agglomeration of frazil crystals that take place during very cold weather. It is a great difficulty that the engineer has to contend with in clear weather with wind agitation that these little harmless particles grow in size very rapidly and form hard masses to which other crystals immediately adhere. Under certain atmospheric conditions ice agglomerates very rapidly and objects placed in the water become rapidly coated with ice. It is a common phenomena that if one lowers a bit of iron or metal into the water when the water is in this state that the iron will freeze at once to the bottom or to whatever ice it comes in contact with.

We designed a suitable form of resistance theremometer and undertook, in the winter of 1896, to determine, if possible, any variation in temperature from the freezing point under the surface ice. Accordingly, a shanty was provided for the instruments in a suitable spot opposite Montreal, and in February of that year the instruments were taken out and observations commenced.

The results of these observations have been published, and it was found during the entire time, with a variation of air temperature from 28 below to 40 above zero, the river under the surface ice never varied as much as 0.01 degree from the freezing point; that during the entire time of the observation no deviation as much as that could be measured, and as a rule

the variations were within a few thousandths of a degree. A severe spell of cold weather would cause a slight drop in temperature, and vice versa.

The following winter observations were made at the Lachine rapids because it was considered that possibly the water under the ice opposite the city came to the freezing point because it flowed so far under the surface sheet of ice. Just at this point the water was running at a very high velocity. This sheet of water is entirely open and flows rapidly from a point about five miles above the dam and sweeps around this curve with a tremendous velocity and a great deal of surface agitation.

Therefore one would expect that if water ever got cooled much below the freezing point it would have a chance in this case. The water was only a few feet deep near the dam, but became rapidly deeper as we got out. The thermometer tube could be bent and placed at quite a distance under the ice edge, so as to be protected from radiation. Measurements were carried out for about six weeks in this position and we got slightly greater variations than under the surface ice the winter before, but as far as the lowering of temperature was concerned it could be limited within 0.01 degree Cent.; and the greatest lowering of temperature observed during a very severe day was 0.006 degrees.

During the two days of rain the river was fairly well cleared of floating ice; very little ice could be seen. On the 12th, a very stormy day with a high wind, 21.1 miles an hour, no sunshine, a mean temperature of about 7 degrees, we found a lowering of the temperature of six or seven thousandths of a degree and the measurements corresponded very closely for the current and quiet water. During the day the river was filled with fine particles of frazil and a great deal of ice was formed.

Table I illustrates very clearly that the margin between the disintegration of the ice and the formation of the ice is exceedingly narrow, only a few thousandths of a degree. The high temperatures are all influenced by the sun's rays being absorbed in the water.

Table II is reproduced to show the effect of the sun's rays in the water.

On the 13th of February, five feet from the surface, we got a measurement of 0.0186 degrees Cent., the air temperature being 16 degrees F.; at two feet it was 0.047 degrees Cent., although the air just above it was at 16 degrees F. On the 15th similar measurements were made. During the time of that measurement, which was in the same locality as before, the deep current and quiet water, three feet from the surface, were both 0.0423 degrees. The sun clouded over and the effect was at once seen in that the temperature had dropped from 0.0423 degrees Cent. to 0.0112 degrees Cent. Now, if the sun had remained cloudy and the air cool, the water would have dropped to the freezing point and a little below. The great influence which the sun has in warming the water is illustrated by the fact that anchor ice never forms and river ice never has any serious effects while the sun is shining.

When the air temperature is sufficient to cause a rapid abstraction of heat the process of freezing goes on and the temperature falls slightly below the freezing.

TABLE I.

Date	Air Temperature Fahrenheit Degrees Max.	Air Temperature Fahrenheit Degrees Min.	Sunshine in Per Cent. if Possible.	Sky.	Wind in Miles per Hour.	Difference from Freezing Point in Degree Centigrade Current	Difference from Freezing Point in Degree Centigrade Quiet Water.
Feb. 3d	+ 20	+ 10	89	Clear	28.6	0	.....
Feb. 5th	+ 32	— 3	88	Clear	9.7	.....	+ 0.0215
Feb. 7th	+ 38	+ 27	00	Raining	13.1	+ 0.0197	+ 0.0182
Feb. 8th	+ 34	+ 28	00	Raining	16.3	+ 0.0547	+ 0.0415
Feb. 11th	+ 18	— 3	94	Clear	6.5	+ 0.0137	+ 0.0151
Feb. 12th	+ 11	— 2	00	Stormy	21.1	— 0.0065	— 0.0068
Feb. 13th	+ 17	0	100	Clear	15.1	.....	+ 0.0186
Feb. 15th	+ 33	+ 24	67	Clear to cloudy	17.6	+ 0.0280	+ 0.0423
March 1st	+ 22	— 10	25	Clear to cloudy	16.8	.....	0

TABLE II.

Date	Sunshine in %	Locality	Diff. from 0° C.	Air Temp.
Feb. 13th	100	5 ft. from surface (bottom)	+ .0186	+ 16° Fahr.
Feb. 13th	100	1 foot from surface	+ .0474	"
Feb. 13th	100	8 in. from surface	+ .0741	"
Feb. 13th	100	Shallow current	+ .0461	"
Feb. 15th	67	3 ft. from surface	+ .0423	30° sky clear.
Feb. 15th	67	8 in. from surface	+ .0819	"
Feb. 15th	67	Just under edge ice	+ .0292	"
Feb. 15th	67	Deep current	+ .0280	"
Feb. 15th	67	Bottom of back water, sun clouded	+ .0112	30° cloudy.

point. The reason for this is probably that ice only crystalizes at a fixed rate. If we abstract heat rapidly enough and the water cannot freeze rapidly enough to keep the temperature up to the freezing point the only thing that can happen is that the temperature must drop a little below.

When the reverse process takes place and heat is applied to the mass of water the ice will not be able to melt fast enough to keep the water cool, and the mass will in consequence be a little above the freezing point. The less the amount of ice present the more the temperature will rise or the lower the temperature will fall for any given rate of gain or abstraction of heat.

I hope I have made it clear that what we have always considered to be a fixed and definite temperature — namely, zero Cent. or 32 degrees F.—is really not absolutely fixed. It varies a little one way or the other, depending upon whether the mixture is receiving heat rapidly or losing it rapidly.

Evaporation would have quite a considerable influence on the loss of heat and consequent formation of ice, but it is probable that it is small compared to the other agencies at work. At night we have a clear sky, practically free from water vapor, and therefore the heat is almost unabsorbed. That is, it passes through the layers of air without any reflection back again. On a cloudy night the rays are reflected back into the water. General calculations can only be made under given conditions. The average heat we receive from the sun is about 0.05 calorie per square centimeter per second.

We know about what the surface of a black body will radiate or how much heat will be given off. Such surface radiation is about 0.0003 calorie per square centimeter per second per degree difference of temperature.

That seems very small, but if you consider what the radiation is from the large surface of a river it seems much greater.

Suppose we made a calculation of how much heat would be radiated at 32 degrees F. to air of 6 degrees F. We find by calculations that about four and a half pounds of ice would be formed per square yard per hour. But if we consider the radiation from the water surface at night into space at absolute zero, then we would get eighty pounds per square yard per hour formed. So you see how very much greater the radiation would be on a clear night and what a large proportion of ice would be formed. That is merely by radiation. Of course, these calculations are based on assumptions which very seldom hold rigidly in actual conditions. From the river bottom there would be a smaller proportion of ice formed. We would get an inch of solid ice formed in about six to six and a half hours.

Municipal Ownership of Gas Works.

By B. F. Lyons, St. Louis, Mo.

The following from a paper before the American Gas Light Association gives the point of view of one on the corporation side of the question of whether a city should own its gas plant or should grant a franchise to a corporation. While this paper discusses ony a few phases of the question, it contains much interesting information.

In this age of industrial progress, commercial pursuit and centralization, we are ever on the alert for natural developments, whether these changes be the result of combination of capital, growth of ideas or whimsical fancies it matters not; the fact still is potent that we are in the midst of events which require and must bring forth inquiry as to their inception, progress, stability and eventual success. These inspections must show whether they have principles involved with withstand the conditions imposed upon them at present and in the future.

Municipal ownership of public utilities and natural monopolies has had the consideration of a sect for a long time past and is now being brought extensively before the general public as a political issue, having been nursed from its embryonic state to a matter of considerable importance by this sect, until it now commands the attention of entire communities. Whether this wave which is forming will continue to move, either for the betterment or to the detriment of the people collectively, lies wholly with the people.

Now that municipal ownership is before the people for consideration, it is for the people to decide what natural monopolies they can economically control, but no decision should be reached merely on the bare statement of men whose hobby and diversion it is to merely pass over these questions superficially, and who have drawn their conclusions from unsubstantiated reports. Furthermore, too much attention should not be given to the opinions of men who are not thoroughly conversant with the principles and details involved in the management and maintenance of the industry which they wish to municipalize. Strange to relate, the technical details which are often brought up for discussion, and upon which so much depends in reaching the proper decision, are seldom thoroughly understood by the sponsors of the agitation. As the result of this wrong interpretation of the data under consideration, the matter is paraded under false colors, although no doubt the

question is being handled in a conscientious manner, and consequently the public in general passes judgment very often detrimental to itself.

Monopoly.—That local gas industry must be monopolistic is not greatly disputed. Past experiences have conclusively demonstrated that competition has never effected the relief which the change contemplated, and that franchises granted to competing companies have in most cases brought on disastrous gas wars from which the consumers and public suffered. The object of bringing in competition was to secure cheaper and better service; the result was final combination of the competing companies with affairs left in about the same condition in which they previously existed, with the exception of a larger investment on which a dividend had to be earned.

In the instance of the city of London, England, we find that, in 1842, competing companies were chartered, the act of 1820 which prevented competition having been repealed. Six companies took advantage of this repeal, and in 1853, when competition was stopped by mutual agreement, there were thirteen different and distinct companies competing in the same territory. London suffered by having its streets torn up continually, by having many different mains on the same street where one would have been sufficient, and from other attendant inconveniences, with the same usual outcome. By 1883 the competitors had so combined that the gas situation was under the control of three different companies, each of which kept in restricted territory, as is also the case today.

Franchise.—In order to permit their formation, protection must be afforded to investors in public service corporations, since their installations usually call for a large outlay of capital. This guarantee of protection usually takes the form of charters and franchises for an indefinite or limited period of time, and when granted has certain provisos concerning termination or renewal under particular conditions.

Inducements for investment depend upon the text of the franchises, and it is incumbent on the public to keep its promises, while the corporation must carry out its part of the agreement in good faith.

Gas franchises should be exclusive during the period they are in force, so as to guarantee the proper protection for the large investment, both against abnormal political exhortation and constantly changing public opinion. Many times the petty personal grievances are distorted until they are made to appear as a general evil, calling for immediate relief; these are hailed by the public spirited Samaritan as the danger signal of an impending public calamity. His false conclusions are hastily proclaimed to his constitutents, and it is against these hasty judgments that the investment should be protected.

The exclusive privilege permits of money being borrowed at a low rate of interest and decreases the liability of loss of the lender. All this works to the public's interest, and probably diminishes the tendency of overcapitalization, upon which extra capital the consumer is called upon to pay the interest.

The exclusive privilege and exemption from competition is often cited as one of the arguments in favor of municipal control, on the theory that these privileges, once granted to a corporation, are abused, the public not sharing the advantages gained by these conditions, while under municipal operations these benefits go directly to the consumer.

This is the popular belief, and perhaps in some cases it does work to the detriment of the people, but I think we can say that as a general thing the burden of proof rests with those who hold this belief. It can be said right here that if the public is to enjoy the results of economical private management, it is necessary that the privately controlled company be allowed the most advantageous conditions under which to operate, and it is positively necessary, in making fair comparisons of the two different systems, that both of them be allowed the means for the accomplishment of most favorable results.

Management.—The modern public service corporation is the result of a gradual growth and development from its crude form, when a few men in the same community co-operated to supply themselves with commodities for personal convenience, to its present form of a highly systematized and commercialized public servant. While in the beginning the matter of delivery, and in some cases the article itself, were considered luxuries, today we do not think of water, gas, electricity, and transportation facilities, as anything else but the necessities and conveniences which the progress of the world has called upon us to accept as such. Bearing this in mind it is evident that production by and management of the public service corporation require the skill and attention of trained specialists in order that the modern standards of facility, quality and cost be satisfied. Herein lies the advantage of privately controlled enterprises which are ever on the alert to find new principles and to apply them. We have but to look around and we can see that every large corporation has its corps of trained engineers, chemists and other specialists whose sole purpose is to determine upon things which will cheapen and better the construction and operation. Take for in-

stance the large chemical and by-product works. Most of these firms have men whose object and duty it is to work on one single idea, no questions being asked as to the length of time it will take to accomplish this purpose. When their research has been finished the company is usually amply repaid for the expense by being able to manufacture this particular substance in commercial quantities, if that was the object of the investigation, or cheapen an already existing process, just as the case might have been.

There can be little doubt that expert and broad business principles of management are extremely necessary. Germany is developing the professional politician, or let us call him an administrative in distinction from a legislative officer, who holds his office as mayor for a long period of years in his own city, and is sometimes even called to manage affairs in other places. We can liken him to managers of incorporated bodies.

The question can be raised as to why we do not adopt such a plan in this country; the answer lies in the difference of our political systems. In our country the municipal officers are subject not only to their party's success, but pleasure, and although a man may have proven a successful officer in the true sense of the word, he may have invited the displeasure of the party leaders, thus terminating the career of a useful public servant, while his party was again successful. The German mayor is appointed to hold office during successful administration, and is not subject to so many political influences.

Now, what is true of our mayoralty holds good for the experts of various departments of our municipalities, and I would like to ask how many successful and energetic engineers would be willing to leave a good position to risk their chances in the hands of a political machine. This can best be answered by yourselves, but the opinion can be ventured that but very few would select a berth where such instability exists.

At the present time the local supply of available expert men for municipal works is limited, and this, too, complicates the selection of the proper head, which usually ends in the choice of a non-resident. What we lack now in this country, and will want until our political systems are changed, is a corps of experts who are willing to forsake private life for public service in expert capacities.

Politics.—Still stronger political machines than now exist will most naturally result from municipalization, and the opinion of no less an authority than Mr. James Dalrymple, the Scottish tramways expert in this particular, is worthy of note. Mr. Dalrymple says:

"To put street railroads, gas works, telephone companies, etc., under municipal ownership would be to create a political machine in every large city that would be simply impregnable. The political machines are already strong enough with their control of policemen, firemen, and other office holders.

"If in addition to this, they could control the thousands of men employed in the great public utility corporations, the political machines would have a power that could not be overthrown.

"I came to this country a believer in public ownership. What I have seen here, and I have studied the situation carefully, makes me realize that private ownership under proper conditions is far best for the American cities."

The argument of direct spoils and dishonesty has been used by one system against the other, and although these conditions have prevailed in the past, it is hoped that our present and future undertakings will be freed from all except pure business principles.

Policies.—Are the policies of municipal gas boards as broad and comprehensive as those of the privately controlled companies? In comparing the conditions of affairs in Philadelphia which existed before the present private management went into control and under the present system, one at once notices the different policies which were in vogue.

Under the old system the works were allowed to run down, the mains were of inadequate size for proper supply and were in very poor condition, as were also the services, which were rusted out, clogged, etc. Some $1,500,000 was expended in the past four years of municipal control, while the present management expended in about eight years of its regime $10,500,000 in order to put the entire system into better shape, so that economical results could be accomplished; about 80,000 services have been renewed by the present company, which in a measure will indicate what was left undone by the Bureau of Gas, although they realized the urgent necessity of so doing, as can be seen from their reports which cover the case as follows:

"Thousands of wornout service pipes could not be renewed during the year because no money was available."

The former represents a policy of expenditures simply large enough to keep things going in a slipshod manner; the latter represents the business policy of rehabilitating, extending and branching out for future requirements, which, of course, means a substantial system and one which will pay dividends.

Wheeling, W. Va., is another example of decline under municipal control. Little or no main has been laid since 1885, no effort is made to get new business, and only repairs which are absolutely necessary to keep things going are made, and the entire system is rapidly going to decay.

It might be well enough to assume that efforts to secure the best possible results are made by the governing bodies of municipal plants, but the question arises whether immediate or ultimate results are what they seek to bring about.

In securing immediate returns the future is ofttimes overlooked, and when of necessity extensive repairs have to be made, the money is raised by direct taxation or appropriated by the council. A supposed brilliant showing during their term of office will reflect credit on themselves and their party. Operating expenses are easy to cut down at the expense of construction and rehabilitation accounts, and these distorted figures show a surplus. This is what they started in to demonstrate, that under a *business administration* they could make money for the city and still furnish as good gas as before for a little less money.

The popular belief that taxes will be lessened, prices reduced and the general burden lightened makes every voter feel that in casting his ballot for municipal ownership he is helping in a philanthropic cause. He argues that the city is entitled to the profits which are going to a chosen few; and why should they not get them, taking it for granted that the same conditions which exist under private administration will exist under public control. He has been told by the stump speakers that it is merely a question of electing the party that stands for the principles, and the much sought for relief will be immediately evident.

The last municipal campaign in Chicago was a fight between one party whose candidate for mayor stood for eventual municipal control of the street railway system and the victorious party whose platform called for immediate municipal control of the same utility. The majority of the people believed that conditions would immediately lend themselves to the magic touch of that panacea for all social ills—municipal ownership. Several months have elapsed and Mayor Dunne and his associates have not yet made public all of their intended policy.

Can it be that a careful study by them has opened up unforeseen difficulties? Has the opinion of the Scottish expert set them to thinking? At any rate, the promises are a little slow in maturing, and the former public enthusiasm is not quite as perceptible.

What is apparently true of the public in general is in a measure true of the public officers. There seems to be less activity, due perhaps to lack of incentive in the administration of affairs of municipally controlled corporations than in those of private companies. The private officers usually feel that they are a part of an organization which will thrive and flourish only in proportion to their personal efforts, and if the results are not forthcoming their removal is probable.

The public officer when he is appointed to a position may feel that if enough influence existed to place him in his position, enough will exist to keep him there, and that his removal will at least be difficult to accomplish. Two cases of this kind have come under our observation in St. Louis this year, where the mayor had plenty of trouble to remove the health commissioner and the commissioner of public buildings, both of whom actually defied displacement. Let us contrast this with the case of a private concern where they would have simply been dismissed, and we will get some idea of how incumbents of public offices regard their positions.

If instead of leaving a movement before it is half finished, it were pushed to a successful issue, more marked results could be obtained, but it seems to be the tendency to partly finish one idea and then pass to a newer plan.

In England it is said that in extending municipalization to so many branches, the tax rates are going up, the taxable property not increasing in value to keep abreast with the popular movement. I will quote an abstract from the paper read by Mr. Dixon H. Davies at the meeting of the Society of Arts, February, 1903. Mr. Davies, in speaking of the local indebtedness, says:

"The subject has grown not only in public prominence, but also in the magnitude of its operations during these four years; but so belated are the returns of the local government board that it is not possible to give statistics which are less than three years in arrears. Making the best of the available materials, it may be said that the local indebtedness of England and Wales now amounts to upwards of £300,000,000—little short of £10 per head of the population. Of this huge sum as nearly as possible one-half has been raised for undertakings which are classed as reproductive. The serious element in this half of the debt is not in its present amount, but its steadily accelerated rate of growth. This element is especially evident in those portions of the debt which have been incurred for definitely trading purposes. To exhibit this, the debt for tramways, electric supplies, housing and

gas has been distinguished from that representing water, cemeteries, harbors and other more legitimate forms of communal adventure. Roughly, the general local debt doubles itself in twenty years; the strictly trading debt in two years.

"Taking a period from 1881 to 1900, and comparing for certain typical cities the increase of the debt and the gross rates with that of the population and valuation, the growth of population has been outpaced by the growth of the debt by no less than 500 per cent. in Sheffield and by 85 per cent. both in Liverpool and London, and by that of the rates by as much as 115 per cent. in Sheffield, 180 per cent. in Cardiff and 250 per cent. in London. The valuation list fails to disclose any increment in the property value at all adequate to those heavy sums which have been charged upon it. In Manchester, for instance, the gross amount levied for rates has increased 178 per cent. in the period, but the property rated has only risen 12 per cent. in value. It is, therefore, difficult to discover any sign of pecuniary advantage to compensate for the added burden. The enormous increase in the amounts levied by the local authorities is obtained not only from a high poundage of the rates, but also from an enhanced assessment of property."

Mr. Davies also makes an important point on the lack of voice of those having more taxes to pay as compared with those who actually alter and make new conditions, as follows:

"Before leaving the figures, attention may be called to the increasing extent to which pecuniary responsibility is becoming divorced from control. An examination of the rate books has been made in two typical northern towns—Sheffield and Manchester. In each case the occupiers of the working class houses represent more than half of the voters' register, while the assessment of the whole of their houses amounts to less than that of the property of the manufacturing, railway and other companies, which have no vote at all. This disproportion is growing, for in both towns the companies' assessment has increased, in the ten years 1890-1900, upwards of 55 per cent., while the small houses only stand at 10.72 per cent. in Sheffield and 21.77 per cent. in Manchester more than they did ten years before (an increase due to the larger number of workmen's houses) so that while the disfranchised class has to pay as much again, the artisans ratepayer and voter contributes about the same as he did ten years ago in the treasury of his town. A democracy surely required that taxation and representation should go together. The figures show that those who provide the greater portion of the funds for the authority are without any voice at all in the election of the local governors or in the control of their policy. So long as they confined themselves to matters of police, health and education, no one complained, for these concern all ratepayers equally. Trading undertakings, on the contrary, are not of equal concern, and the control of them cannot justly be vested, except in those who provide the funds for carrying them on. Property qualifications are out of fashion nowadays, but if our municipal institutions are to be saved from the discredit and disaster which unjust practices of this kind will surely bring upon them, means must be found to confine them to the proper functions of government."

Australia is also in the throes of too much municipalization, or, as it has been aptly put, "Governed to death." The public utilities are under the control of experimentalists, and the country is feeling sharply the burdening effects of operating public utilities as an adjunct to the political organization.

In the United States, where it should be admitted that our present political systems do not present anywhere near as good conditions and circumstances as prevail in England, Scotland and Australia, for the sucess of extending municipal ownership to a great many kinds of business, we should take heed and profit from the mistakes of our European friends.

Up to the present time we have not departed very far from the old policy of privately conducted business, and we are not in any particular danger of impeding the great progress which is bound to result in a country abounding in so many natural resources, and where energy is a predominating characteristic of the people in general, but we are ready to adopt any plan which will benefit the greatest number.

If our present systems and institutions are all wrong, the errors will be adjusted as rapidly as the difficulties appear. We do not argue that the present form of private corporation is ideal; it may need regulation. We have not all agreed that the gigantic trusts are entirely in accordance with strict economic principles, but we are all of the same opinion that all these difficulties will disappear if the proper interest is manifested by every citizen in each of the public questions in the due order of their importance.

In the United Kingdom, where municipal and private ownership have worked side by side for many years past, we do not find such great differences in results accomplished by the companies themselves. According to the return of the Board of Trade from the period 1887 to 1904, the privately owned gas works in-

creased from 384 to 428 in number, while the municipal plants increased from 168 to 260.

In 1887 the percentage of total gas works which were municipally owned was 30 per cent., increasing to 33 per cent. in 1903, or in 16 years 3 per cent. has marked the advance of strict municipal ownership as applied to gas works in England. This may not be very gratifying to those exponents of the doctrines who are always pleased to quote English practice and point out what rapid strides are resulting from municipal ownership, but it means that if private control was not properly regulated twenty years ago it is doing quite as well under the present conditions as municipal ownership; and if it is satisfactory, as we are led to believe, there is a great deal of unnecessary agitation. Furthermore, the English people must see some greater difficulties ahead, for there can be no doubt that from its very nature municipal ownership is bound to be a popular movement.

At present there are twenty-five municipally owned and operated artificial gas plants in the United States, which supply cities varying in size (according to the census of 1900) from 573 to 85,050 inhabitants.

From the report of the Commissioner of Labor, 1899, we find that 951 privately owned and about fourteen municipally owned gas works were being operated, making a total of 965 works in this country. Of that total the municipal works represented 1.4 per cent., practically a negligible percentage. Now, if we consider that the total number of gas works had not increased any in the past six years, and compute the percentage of the total plants on the basis of those which are now municipalized, we find that this percentage is 3.7. These percentages speak for themselves. The small number of municipal gas plants in this country may not be due to present private systems giving perfect satisfaction, but it is a testimonial of confidence in the general principles of private control, at least as far as the present generation is concerned. On the other hand, Paris, Ky., has repudiated municipal ownership and has sold its works recently to a private company.

Philadelphia is experiencing a satisfactory service under the management of the present lessees. Wheeling is at a loss to know what is the best plan to pursue in the future, and a great number of the municipalities do not really know whether they are operating successfully or not, so probably the municipal operations should be questioned.

Mr. Richard T. Ely, a noted authority on municipal affairs, in his book, "The Coming City," brings out this point very forcibly. Prof. Ely says:

"One of the first and most essential reforms in American cities is an improvement in financial methods. Municipal accounting needs a thorough overhauling, and a good budgetary system must be part and parcel of every excellent municipal government."

The following table will show that the problem is limited to cities of small sizes:

TABLE I.—*Municipal Plants in the United States.*

Name.	Population U. S. Census, 1900.	Year Municipalized.	Present Price of Gas		Price of Gas Year Previous to Municipalization		
			Fuel.	Ill.	Fuel.	Ill.	
Talledaga, Ala.	2,661	1901	1.00	1.25	1.25	1.75	
Norwich, Conn.	17,251	1904	1.25	1.25	1.26	1.55	
Cartersville, Ga.	2,500	1903	4.00	4.00	....	....	Oil gas.
Dalton, Ga.	4,315	1900	1.00	1.00	1.50	1.50	
Henderson, Ky.	10,272	1882	1.00	1.00	1.50	1.50	
Westfield, Mass.	12,310	1899	1.47	1.47	1.60	1.60	
Wakefield, Mass.	9,290	1894	1.69	1.69	1.60	1.80	
Middleboro, Mass.	6,885	1893	2.10	2.10	....	....	Oil gas.
Holyoke, Mass.	45,712	1902	1.32	1.32	1.35	1.30	
Escanaba, Mich.	9.549	1895	.75	1.50	1.50	1.50	
Duluth, Minn.	52,969	1898	.75	.90	....	....	
Adams, Minn.	573	....	1.50	1.50	....	....	
Renville, Minn.	1,075	1903	1.50	1.50	1.50	1.50	
Rich Hill, Mo.	4,053	1903	1.00	1.00	2.00	1.50	
Hamilton, O.	23,914	1890	.80	.80	2.00	2.00	
Bellefontaine, O.	6,649	1873	.75	1.25	....	....	
De Smet, S. D.	749	....	2.00	2.00	....	....	
Richmond, Va.	85,050	1852	1.00	1.00	....	....	
Danville, Va.	16,520	1876	1.00	1.00	4.00	4.00	
Alexandria, Va.	14,528	1853	1.20	1.20	....	....	
Charlottesville, Va.	6,449	1876	1.00	1.00	3.50	3.50	
Fredericksburg, Va.	....	1891	1.25	1.25	3.00	3.00	
Wheeling, W. Va.	38,878	1870	.75	.75	3.50	3.50	
Gilroy, Cal.	1,820	....	2.50	3.00	....	....	
Santa Clara, Cal.	3,650	....	1.75	1.75	....	....	

In addition to the above the following plants have municipal control:

No Gas Works (gas bought from neigh-

boring town)—Reading, Mass.; gas bought from Wakefield.

Works in Which City Owns Part Interest—Louisville, Ky., city owns about one-fourth interest; Danville, Ky., city owns about one-fifth interest.

Works Owned by City, Leased to Private Company—Philadelphia, Pa.

SUMMARY.

Works operated and owned by city	25
No works—gas bought and supplied by city	1
Gas works in which city has interest	2
Works leased to private company	1
Total	29

Comparisons of Gas Companies.—The inadequacy of sufficient and reliable data increases the difficulty of making proper comparisons of different situations. The fourteenth annual report of the commissioner of labor contains a great deal of general information of gas companies and shows very clearly the varying conditions in the United States. From these statistics it is very evident that whatever general classification is made the lack of uniformity of the data is very prominent, and this can be explained by saying that each city has its own peculiarities and conditions. This is recognized by the leading social scientists, but if it is necessary to compare two cases it would be well to take into account certain salient features which would make the comparisons more equitable.

Interest and Capital.—The first question that might be raised is that of the total investment. The capital charge per 1,000 sold is always an important item, so necessarily the rate of interest must be known. It has often been argued that only such interest charges should be made as are represented by the interest on the duplication value of the plants. This has always been a very convenient method of showing up exorbitant profits.

Let us take the usual example: "A" builds a plant for manufacturing a certain article and the investment in the plant, etc., at the end of five years is represented by $10,000. At that time "B" opens up his factory, of the same capacity, to manufacture the same article, and $7,000 represents his investment. "A" will have to earn interest on his investment of $10,000, while "B" has only $7,000 to earn interest on, and therefore ought to be able to place his commodity on the market cheaper than "A," as far as an interest charge is concerned. Now, there is no way of getting around this unless we charge off a sufficient amount for depreciation and consider that the interest separately earned on the depreciation fund is used for making up the discrepancy. Coming back, however, to the original proposition, we find that there is a great diversity of opinion on this matter, but it is the present accepted practice to charge interest on the entire investment value and not on the duplication value.

Then there is another case, such as occurred at Haverhill, Mass. Originally, in 1871, the capital was fixed at $75,000, no attempt being made to increase the capital through the prosperous years, but due to careful and skillful management a surplus of $300,000 was accumulated in the shape of new plants, extensions, etc. Calculating the profits on the original capitalization, the earnings seemed high, so the mayor and others petitioned the State commissioners to reduce the price of gas to such a price as to enable the gas company to only earn dividends of 8 per cent. on its original capital of $75,000. While the petitioners asked for a reduction to 70 cents, the commissioners allowed a reduction to 80 cents per 1,000. This decision will have the tendency to discourage the same diligence in management and practically amounts to municipal ownership of the plant, simply paying the operating company 8 per cent. on its original investment for assuming the risk to operate the same, besides standing liable for any losses which might be incurred. This illustrates why the exact and full information would be needed in comparing Haverhill with some other company just on the points of capital and interest alone.

Depreciation.—Many of the municipal plants are neglecting to make the proper charges for depreciation, and even if we would compare two places, one privately and one municipally operated, where depreciation was a recognized charge we would find that each would have its own peculiar system, one perhaps charging off 3 per cent. and the other 5 per cent., depreciation being considered a function of local conditions. But since the depreciation fund has been considered in accordance with sound principles, note should be taken of its absence and the proper charges should be made.

Taxation.—We have read much of the inequality of taxation of large corporations, we have voted on laws covering certain phases of the subject, but we can not understand why the taxes relinquished on industry by reason of municipalization should not properly be charged in figuring the costs and profits of the municipal undertaking. The city's property actually subject to taxation will certainly be decreased and the income decreased unless the municipal plant be considered in the same way that the privately owned plant is and a corresponding tax exacted. In England this is a recognized principle, and it is only fair that consideration be given to the idea in this country. Here

again we can not fail to notice what a difference local conditions might make in comparisons.

Location, Effect on Raw Materials and Residuals and Labor.—Geographical location and railroad and other transportation facilities play a great part in the cost of raw material. In a great many instances the freight rate greatly exceeds the cost of coal, so if two different companies are manufacturing coal gas, and one is situated in the gas-coal region while the other is many hundred miles distant, we would hardly expect the cost of coal per 1,000 made to be the same. However, the place where the coal was more expensive would probably offer a better market for coke, thus some of the difference might be reduced; but attention to these points will not fail to bring out a fairer comparison. What holds good for coal holds good for oil and the other raw materials, and in a certain degree for the residuals, so it is well to give due weight to the difference in the market. We find, too, that labor conditions vary in different localities, some places being strongly unionized, some cities having in abundance cheap foreign element, and where corporations employ a large force, as gas companies do, a general survey of the wage question will be an aid in deductions.

Consumption.—Consumption per consumer per capita, per meter, per mile of main, capital per 1,000 sold and the like, will assist in the examination, for these, with the other necessary data, will at once tell much to the trained mind of the manager of the present results and the prospects of future business.

Candle Power and Quality.—A difference of a few candles will, of course, affect the cost of manufacture within certain limits; likewise a gas of low heating value should not be directly compared with one a great deal higher in B. T. U.'s, and while it would take a long series of calculations to make a fair comparison of the two gases the difference of quality should not be concealed by saying "City A" furnishes nearly as good gas as "City B," but cognizance should be taken of the fact if there is any great difference in these particulars.

Extra Charges.—The net price for gas does not always tell the whole story. There is some importance in the quality of service. It must be some convenience in being able to have an ample supply of gas when you need it; there is surely some advantage in being able to buy the latest appliances at low rates, have them connected up free of charge, have services run without expense, meters installed without a monthly rental charge. If the housewife is taught how to get a maximum efficiency out of her gas stove she appreciates it, but hardly stops to think of the saving in gas thus accomplished. Some companies have a staff of demonstrators who give this instruction free of charge. In some of the larger cities, where the volume of business has greatly increased, different rates for discount have been established for the convenience of the customer; they have even gone so far as to establish substations at which gas bills can be paid without an additional expense, in proximity to the homes, and while these things appear to amount to little and have been done for mutual benefit and gain, they should not be overlooked in comparing with companies where the same courtesy and facility do not exist.

While it will be impossible to obtain the proper data in all cases for comparisons, and probably the truth may never be brought out, it will be fairer to all if parallelisms be drawn only after the examples are reduced to as near the same basis as possible.

It was the original intention to take the data of the municipal plants and compare them with those of privately owned corporations. A list of questions was mailed to the important municipal plants, but the responses to the requests for the information were so few, and such information as was received was so lacking in detail and uniformity, that the idea had to be abandoned. We do not attribute the failure to comply with our requests to the lack of desire to furnish the figures, but rather to the absence of such data on their own books.

Statistics.—We will now take up the situation at Wheeling, W. Va., and, with the aid of a few figures, will try to bring out some of the peculiarities which may arise under municipal ownership. It is the popular belief that Wheeling is an example of municipal success, but, as will be seen, there are some grounds for doubting this contention.

Wheeling, W. Va. — We have chosen Wheeling, W. Va., as one of the cities typifying the early idea of municipal ownership of gas plants. This city has often been cited in substantiation of the principal arguments for this doctrine. The gas works was taken over by the city in 1870, when $100,000 bonds were issued to purchase the same. The management and supervision of the gas works are vested in three trustees, who hold their office for two years. The trustees appoint such officers as superintendent and secretary, and also pass on applications for positions at the works under the superintendent.

When municipal control was assumed the price of gas was $3.50, and by successive steps the price was reduced to $1 gross

or 75 cents net if paid by the 10th of the month, remaining at this price for at least the past sixteen years.

The city manufactures straight coal gas of 16 candle power and sells it for illuminating purposes, as natural-gas competition at 18 cents per 1,000 practically prohibits the use of artificial gas as fuel. One of the clauses of the Wheeling natural-gas company's franchise is intended to prevent the sale of natural gas for illuminating purposes, but some enterprising citizen recently took exception to the law and was promptly prosecuted. In his decision on the case last June Judge Hugus held that the city has no right to say what shall be used as an illuminant, and if the natural-gas company chose to sell a customer gas for illuminating purposes he could use it, but he also pointed out that the city could proceed in a civil suit against the natural-gas company for violation of its contract. Pending the outcome of this controversy, the municipal gas company is at a loss as to what future policy to pursue. It is evident that if a decision is handed down in favor of the natural-gas company the city will either have to buy out the natural-gas company, which it can do according to the terms of the franchise, or reduce its price for gas so as to be able to compete with natural gas, and it seems as though the former would be the only logical course to follow. We can see no good reason why the municipal plant should not be entirely abandoned and the people be allowed to enjoy the benefits of the much cheaper natural gas. Municipal ownership should not be allowed to prohibit the people from taking advantage of this much cheaper commodity merely to maintain the artificial-gas plant because it now exists. In the meantime the much-needed repairs and extensions will be postponed.

To get some idea of the present condition of the manufacturing plant we need only say that some prominent consulting engineers have estimated that it will take at least $70,000 to put the existing plant in condition to meet the present demand, but a personal visit would immediately impress on your minds the state of deterioration. The taxpayers of Wheeling were greatly astonished at the report of the engineers, and they now realize that the last policy of supporting a municipal electric-light plant at the expense of the gas plant is disadvantageous. It is not surprising that the general public did not know the true condition of affairs, for they had their board of trustees to attend to these details, but they were easily awakened to the fact that there must be something else to the management and operation of gas plants besides shoveling coal into retorts and collecting the money. All of the calculated net earnings of the gas department which were figured as profit (no account, however, having been taken of such items as interest and depreciation on the investment, or taxes) were diverted into the electric department fund, and this balance went to defray the expense of public street lighting. Instead of using this supposed surplus for either reducing the price of gas or making the necessary repairs (the former of which, according to municipal ownership exponents, is one of its great benefits), it was used in making the gas consumer pay more than his legitimate share of the street-lighting expense.

The ratio of taxpayers to consumers is about 3 to 1; therefore one-third of the taxpayers (provided all the consumers are taxpayers, which is hardly probable) contributed $27,355.36 in 1904 for lighting the streets, besides giving to the gas works simply as that portion of the total number of taxpayers $20,505, which was appropriated by the Council for the support of the gas works. Similarly in other years past they have paid this double tax for the benefits in which the entire population of 40,000 people shared.

Consumption.—In 1890 Wheeling sold 30,012 cubic feet of gas per consumer, and in 1904 sold 22,338 cubic feet per consumer, a net decrease of 36 per cent. in fourteen years, while the sales per capita decreased from 3,301 to 2,775, or about 19 per cent. during the same period of time. This would all show that although gas has been increasing in popularity throughout the United States, Wheeling has been going backward, but it must not be forgotten that natural gas is sold at a very low rate for heating purposes. Granting that natural gas has made inroads into the city gas company's business, the statistics should not show such a large decrease, and if a private corporation was seeing its business slip away at this rate it would surely have bought out or combined with the natural-gas company, which, in either case, would have greatly benefited the consumer.

You will all agree that the management by a city of a public-utility corporation should not differ from that of a privately controlled company in that the invested money should yield a certain minimum rate of interest; the depreciation of the plant should be properly provided for and should be charged the same, with the taxes, etc., as a privately controlled corporation. If, after all these charges are properly made and the necessary repairs, extensions and improvements are carried on in accordance with a broad policy,

the returns show a profit, then, and only then, can the venture be called successful.

Wheeling has been neglecting to charge interest, depreciation, etc., and has apparently made a good showing, but a casual glance at the statistics will point out to you their fallacious belief.

The total net cost of gas per 1,000 sold for the years 1902, 1903 and 1904 varied from 61 to 68.9 cents, averaging 64.7 cents. Add to this the average interest, depreciation and taxes per 1,000 sold, and we find that the gas, if the proper charges had been kept, would average 98.2 per 1,000 sold, and that the average loss per 1,000 sold would be 22.6 cents. On further examination of the data we perceive that as much as 23 per cent. of the gas made is unaccounted for, and that the yield per pound of coal in 1902 was only 4.12 cubic feet, but has come up to 4.22 cubic feet in 1904. The leakage and the poor yields certainly account for some of the poor showing, indicating also laxity in operation, which is generally true of municipal plants, and, regardless of what has been said to the contrary, this particular case illustrates the point.

Extra Charges.—The usual fees for resets, services and installation are charged.

MUNICIPAL AND TECHNICAL LITERATURE

Municipal Reports—New Publications.

Municipal Reports.

Thirtieth Annual Report of the Water Board of Bangor, Me., 1904-5, Melville A. Sinclair, Superintendent.

The net cash revenue of this municipal department was $66,829.59 for the year of the report, and the collector points with pride to the fact that this is the eighth consecutive year in which all dues have been collected.

The city departments and charitable institutions receive without charge water which is valued at $14,816. The expenditures for the year were $72,029.68, and the city would receive its public water service at very low rates if it met the overdraft. The interest account seems to require $44,945, but in the itemized account it is said that $10,000 of this is for note paid, without statement of the application of the proceeds of the note. The city might well pay off some of the bonded indebtedness by the plant as an offset for the free water it receives and thus relieve the works of this heavy burden and make possible a reduction in rates in the future.

The average consumption of water per day was 3,778,436 gallons during the year, an increase of nearly 300,000 gallons over the previous year. The population being about 22,000, this shows an average per capita consumption of 170 gallons a day, which is increasing, as the population is not increasing as rapidly as the average daily consumption.

Ninth Annual Report of the Department of Water Works of Kansas City, Mo., 1904-5, S. Y. High, Superintendent.

The report is made by the former superintendent.

The supplementary summary of revenue received and cost of water during the year by Superintendent High at the close of the report seems to have been made by somewhat different classification than the main report, as items do not agree exactly.

The receipts are given as $623,729.70.

The sum of the operating items is $249,999.62. Taxes in Kansas were $11,000.44. Interest on bonds, $161,262.50. Charges for depreciation are made, on plant, $71,176.12, and on betterments, $36,975.93, making the total charges against the revenue $530,414.61. This shows a profit of $93,315.09.

Free water to the city and some charitable institutions is estimated to be worth $140,300.

The city has 9,885 meters in service. It cost $4,267.64 to read these meters, and about $4,300 for repairs to public and private meters. Setting meters cost $6,782, with 1,172 for meter boxes. Consumers paid $11,232 of this amount as charged them for setting and repairing meters and putting in meter boxes.

The analysis of the report is difficult, and exact separation of items is impossible because of the different principles upon which the various tables are prepared. If the management should adopt the forms of report approved by the American Society of Municipal Improvements, which include the standard form of summary now adopted by nearly all waterworks associations, greater clearness would result and the department, as well as students of the reports, would receive much benefit.

New Publications.

Cement and Concrete. By Louis Carlton Sabin, B. S., C. E., M. Am. Soc. C. E. 517 pp., 161 tables. Cloth. $5. McGraw Publishing Co., New York.

The principal part of Mr. Sabin's book will be found in Part III, which occupies about 200 pages, and is devoted to the subject of the preparation and properties of mortar and concrete. The basis of the discussion is in some original investigations made by the author, in connection with the construction of the Poe lock at the St. Mary's Falls Canal, which he was given unusual oportunities to make. The investigation took up in detail the differences between silicious and calcareous sands, the effect of fineness upon sand, the voids in the sand and the effect of handling, moisture, size of grains and impurities upon them and upon the mortar made from the sand. It gave full data for determining the proportions of the ingredients of mortar of various materials and strength, the methods of mixing and the cost of mortar of various kinds. It furnished similar data regarding broken stone and gravel, the methods of proportioning concrete, of mixing by hand and machines of several kinds, and the cost of mixing and placing concrete. Plenty of sample cubes and briquettes of all the kinds of mortar and concrete investigated were made to give, under test, the fullest information regarding the tensile and adhesive strength of mortars of all the various kinds, showing the effect of variations in materials, in proportions and in methods of treatment, and the effect of age was also well shown. The use of plaster, clay, powdered limestone, brick, sawdust, terra cotta, lime, etc., was tested, as well as the effect of cold, of the use of salt water, etc. This study extended to the adhesion of mortar to stone, brick, steel, natural and Portland cement, concrete, etc. The compressive strength, the modulus of elasticity and the cross breaking strength of mortar and concrete were thoroughly studied. Shear, abrasion, effects of temperature changes, fire-resisting qualities, preservation of iron and steel, waterproofing, efflorescence, etc., are also treated in this section of the work.

It is probably clear, from the description, that the book is invaluable for the engineer who wishes to make the best specification possible for the materials he has for use, and that it will save the time, trouble and expense of himself making complete tests of his materials. The book fills the demand for this kind of work as no other book attempts to do, and is one of three books which every cement engineer requires, viz.: Mr. Sabin's, for guidance in fixing proportions and methods of handling materials; such a book as the "Handbook for Cement Users," for thoroughly tested forms of specification; and a book of the class exemplified by Taylor and Thompson's "Concrete, Plain and Reinforced," for descriptions of practical application of concrete under the various conditions met in construction.

To complete the idea of the book, Mr. Sabin has included in Part I a history and description of the various kinds of cement and sketches of the methods of manufacture, and in Part II, full statements of the methods of testing cement and mortar.

He has also added Part IV, giving short descriptions of methods of using mortar and concrete, including the methods of depositing concrete in air and in water, and the principles upon which molds are constructed; reinforced concrete of various kinds; the use of concrete in buildings, walks, floors, pavements, curbs, foundations, sewers, tunnels, reservoirs, piers, piles, arches, dams, locks, breakwaters, etc. This part has been expanded in several recent books by other authors to cover many pages, some of the books being devoted to but one or two of the subjects mentioned. The space is well used, however, when its limitations are considered and the book would be incomplete without it.

The practical man, confined to a single class of work, has been heard to say that the book was not for him, but when he wishes to change his class of work, and for the majority of engineers, who are frequently changing materials and conditions, the book is considered well nigh indispensable.

Calcareous Cements: Their nature, manufacture and uses, with some observations upon cement testing. By Gilbert R. Redgrave, Asso. Inst. C. E., and Charles Spackman, F. Chem. Soc. Second and revised edition. 310 pp. 63 illustrations. Cloth. $3. J. B. Lippincott Company, Philadelphia.

This is a thoroughly revised edition of a book, the first edition of which was reviewed in MUNICIPAL ENGINEERING, vol. xxiii, p. 470. It is written by English-

men for Englishmen, and, while English practice has not yet been completely modernized, the changes have been so great that it has been necessary to rewrite the chapters descriptive of methods of manufacture and to revise the others to conform to the changes made necessary by the change in quality of cement. This edition seems to be prepared with some idea of showing the backward English manufacturers what their competitors are doing, and it gives very fair ideas of the best methods in use on the continent of Europe and in the United States.

The book is devoted almost entirely to the manufacture of cement, lime and plaster, including methods of making chemical analysis of cement and of the raw materials. There is a short chapter on the composition of mortar and concrete. Two chapters give methods of testing cement, one gives standard English specifications for cement. Two chapters describe the manufacture and give the composition of special cements, such as Scott's, selenitic, sidero, slag, etc.

Appendices give tests of mortar and selenitic cement, German and American standard cement tests, and studies of the effects of sea water on cement, the cost of cement manufacture and Dorking stone lime.

The book gives the best general treatment of the manufacture of cement to be found in any one book in the English language.

The Adjustments of the Engineer's Transit and Level. Howard C. Ives, C. E., Univ. of Penn., Philadelphia, Pa.

This little sixteen-page pamphlet gives simple methods of making the adjustments of the Y-level, the dumpy level and the transit. Until one has the principles of the adjustments thoroughly in mind, he should have such a statement as this one close at hand. This one is convenient because it is thin, but might be even more so if the pages were smaller, so that the book could be put into a vest pocket.

The Modern Asphalt Pavement. Bq Clifford Richardson, Director of the New York Testing Laboratory, Long Island City, New York. 587 pp. Cloth, $3.00. New York, John Wiley and Sons.

Mr. Richardson presents the first book of importance devoted to the asphalt pavement, and, while it sometimes reads like a brief for Trinidad pitch lake asphalt, on the whole it is the most satisfactory as it is the most detailed discussion of the subject. If the reader will make allowances for the author's evident bias for the material on which he has labored almost exclusively for so many years, he will find the book a mine of information, a collection of practical and theoretical points which he can find nowhere else. The author writes for all classes of readers, including engineers and asphalt experts, and in his preface advises the general reader, the property holder and taxpayer what chapters to omit and what chapters contain the information desired by each.

The concrete or other mineral base and the intermediate binder or cushion coat are the subjects of the first part.

The second part takes up the surface mixture, with chapters on the mineral aggregate, the filler or dust, the nature of the natural bitumens, their characterization and classification.

The third part takes up in detail the native bitumens used in paving, including petroleums, solid bitumens, and the individual asphalts. The author's intimate knowledge of Trinidad asphalts is clearly shown in this chapter, and the only regret is that it does not extend with equal minuteness to other asphalts if one may judge from his discussion of them. Other chapters in this part consider bituminous minerals which are not asphalts, asphaltic sands and limestones, and residual pitches derived from petroleums and other sources of manufacture, with a comparison of various native asphalts as to their value for paving purposes, wherein the author's high opinion of the Trinidad product is still further detailed.

The fourth part is devoted to the technology of the paving industry, including the refining of solid bitumens, the making of surface mixtures, and comparisons of their relative merits, asphaltic concretes, such as asphaltic or bituminous macadam and asphalt blocks, and the process of combining the various constituents into a surface mixture, with descriptions of the various processes and machinery.

The fifth part puts the asphalt on the concrete base, describing processes and machinery.

The physical properties of the completed asphalt surface are discussed in the sixth part. Radiation, expansion, contraction and resistance to impact and their effects on the pavement and its surrounding are briefly but thoroughly treated.

The seventh part presents specifications for laying and maintaining a Trinidad pitch lake pavement, most of which are equally valuable for pavements using any other good asphalt, shows the merits of the modern sheet asphalt pavement, and gives a detailed, though somewhat one-sided, discussion of the effect of water upon asphalt pavements.

The causes of defects in asphalt pavements due to errors in design and con-

struction, unfavorable environment and age, are set forth in the eighth part.

The ninth part considers the control of the work to reduce the chances of the occurrence of these defects, gives instructions for collecting and forwarding samples of materials and mixtures to the controlling laboratory and full descriptions of the methods and apparatus employed for the chemical and physical examination of the various materials and their combinations, with special chapters on the solvents of asphalt which are in use and on the equipment of its laboratory.

Mr. Richardson has long held a position at the head of the scientific department of the asphalt industry, and this book coming from him carries more authority than would one by almost any other author. It has long been needed, and the author will receive the thanks of those interested in the subject for so complete a treatise, with little complaint of its limitations in the directions mentioned.

A Treatise on Concrete, Plain and Reinforced. Materials, construction and design of concrete and reinforced concrete. By Frederick W. Taylor, M. E., and Sanford E. Thompson, S. B., with chapters by R. Feret, William B. Fuller and Spencer B. Newberry. 585 pages, cloth $5. John Wiley & Sons, New York.

The authors of this book are practical men with college training, who are engaged in the design and construction of concrete work. They have succeeded in making a practical book, which is as coherent and in most cases as self-consistent as is possible at this stage of the development of the use of concrete and reinforced concrete.

The first chapter contains a list of definitions and of data regarding weight, volume, properties, strength and methods of handling plain and reinforced concrete and the materials of which it is composed. There is also a set of tests of cement to be used by small purchasers. The word "data" is used by the authors as though it were in the singular number, thus giving some little authority to an error often made by engineers who have had no Latin in their school course.

The second chapter is a rather popular elementary outline of the process of concreting, including selection, proportions and quantities of material, tools for concrete work, forms, mixing and laying and approximate cost and strength of concrete.

The third chapter gives specifications for the purchase of various kinds of cement, for making and laying concrete and for steel reinforcement, all in brief, suitable for ordinary small contracts.

The principles upon which the choice of cement should be based are stated in the fourth chapter very briefly as regards all but the question of cost and not exhaustively regarding any point.

Cements are classified according to various American and French authorities in the fifth chapter, and the chemistry of their action is quite fully treated in the sixth chapter, which is by S. B. Newberry.

The standard methods of testing cement of the American Society of Civil Engineers are given in the seventh chapter, with many comments and additions from other sources and drawings of details of apparatus. A list of laboratory apparatus and discussions of fine grinding, quantity of water, rate of setting, standard sand, testing machines and soundness are added. The eighth chapter is devoted to special tests for color, weight, compressive and transverse strength, adhesion, shear, abrasion, porosity, etc.

The strength and composition of cement mortars is the subject of the ninth chapter, and is the first chapter which shows the effect of the special studies made by the authors. The effects of density, size of sand, quantity of water, sharpness and purity of sand, lime, substitutes for sand, gravel, broken stone, regaging and sea water are considered, some in detail and others incidentally. Specific gravity of stone, proportions of voids and coarseness of sand are considered in some detail in the tenth chapter. These lead up to the eleventh chapter on proportioning concrete, which is written by William B. Fuller, and goes into considerable detail regarding the principles of proper proportioning, mechanical analysis of materials, determination of voids and methods of determining proportions from the information thus obtained. Tables of quantities of materials required for concrete and formulæ for the same are given in full in the twelfth chapter.

The thirteenth chapter treats of the strength of plain concrete, compressive, transverse and shearing, with formulæ and tables and estimates of factors of safety, data regarding progressive increase in strength of concrete and modulus of elasticity, and comparisons of concrete of various materials, especially gravel, broken stone and cinders. Methods of making samples for tests are also described.

Chapter fourteen, on reinforced concrete, is perhaps the least satisfactory of the chapters, which may be termed the authors' own, because sufficient care has not been taken to make it homogeneous, and the results of the various experimenters and those derived from the formulæ are not carefully compared to show their conformity to fact and theory, and thus

some quite serious discrepancies may be shown, as, for example, in comparing the tables on pages 302 and 309 with Professor Talbot's tests. The emphasized item on page 309 is considered by some to be too close to the danger line. On the other hand, the solution of example 11, on page 307, gives 57 pounds per square foot as the net safe live load on an 8-inch slab, 16 feet span, with 0.007 of steel reinforcement, whereas in a paper before the Western Society of Civil Engineers Mr. T. L. Condron reports a floor slab 15 feet square, 8 inches thick, with 0.008 of steel reinforcement which was actually loaded with 1,200 pounds per square foot, with a total deflection, including the deflection of the supporting beams, of only ¼-inch, with no cracks in the concrete. As has been stated in reviews of other books on reinforced concrete, the theories have not as yet sufficient basis in fact, and these differences between theory and practice not developed together must be expected until more tests have been made and methods of design have become more definite and more uniform. There is much in this chapter that will be found of special value to the designer in reinforced concrete, and it is only intended to call attention here to the doubtful passages which this book contains in common with the others which have appeared that the engineer may proceed with due caution.

The preparation of materials for concrete is the title of the fifteenth chapter, including screening and crushing. The sixteenth chapter mixes the concrete by hand and by various forms of mixers, types of which are illustrated and described, as well as complete plants for mixing, conveying and depositing concrete. The latter operation is more fully described in the seventeenth chapter, the operations of transporting, depositing on land and in water, ramming, puddling, bonding old and new, making joints and facing being illustrated and described, as well as forms for mass concrete, laying of rubble concrete and placing of molded blocks.

The effect of sea water upon concrete is discussed in chapter eighteen by R. Feret, and the laying of concrete in freezing weather in chapter nineteen.

Water-tightness and method of attaining it are well considered in chapter twenty, part of which was printed in MUNICIPAL ENGINEERING some months ago.

Protection of steel from fire and rust is the title of the twenty-first chapter. Sidewalk and basement-floor construction is described in chapter twenty-two, and concrete building construction in chapter twenty-three. The latter chapter treats concrete floors and girders and methods of reinforcing them in some detail; also concrete stairs, roofs, walls, columns, plastering, chimneys and blocks in less complete manner. Foundations and piers, including piling, footings, etc., take a short chapter, and dams and retaining walls another. Arches, tunnels and conduits are given a little more space, and reservoirs and tanks receive some attention.

The book closes with a chapter on methods of cement manuufacture; thirteen pages, in fine print, of references to concrete literature, which will be very acceptable, and appendices giving the suggested methods of analysis of cement and cement materials, and some additional formulæ for reinforced concrete beams.

For many purposes this will be the most convenient book on its subject which has appeared. Each of the recent books has had a different object in view, and each has as its core a different set of investigations and experiments, concerning which it is specially valuable, the remainder being a compilation from other sources. This book is perhaps the most directly applicable to problems of handling concrete and the materials of which it is made, and to determinations of proportions, and will serve as a guide in more or less detail to other parts of the subject. It should certainly be in every engineer's library, and contractors will find it of much value.

Hendricks' Commercial Register of the United States for Buyers and Sellers. Fourteenth annual edition; over 1,300 pp.; 350,000 names and addresses; over 14,000 classifications. Cloth, $7. S. E. Hendricks Co., New York.

This book comprises a complete and thoroughly classified register of every branch of the architectural, engineering, mechanical, electrical and kindred trades and professions of the United States, is issued annually and covers the entire country. Take the least unit that enters into the requirements of any craft, turn to the index, and you will be sure to find it listed with the page on which all the manufacturers of the article in this country is given. The great and essential quality of the work is its thoroughness. It does not give just the names of the firms patronizing the publishers, but the name, address and business of every firm, regardless of any patronage. For a railroad it gives everything from a track spike to a locomotive, for a machine shop everything from a nut to a traveling crane, for a farm everything from a hoe to a steam plow, and so on through the whole list. The classifications are carried out in an especially convenient manner for reference. All the larger trades or professions are classified by States, but in manufacturing branches where the

firms are few, the classification is alphabetical. It gives not only the name and address of the manufacturer, but also the name and address of the customer. It contains many valuable mailing lists of the entire country.

Properties of Steel Sections. A Reference Book for Structural Engineers and Architects, including tables of moments of inertia and radii of gyration of built sections, examples of sections selected from monumental structures, unit stresses, safe loads for columns, plate girder design, design in timber, etc., with only sufficient text to explain their application. By John C. Sample, C. E., M. Arch. 121 pp., cloth. McGraw Publishing Co., New York.

The above description, taken from the title page, gives the scope of this volume, which should serve the purposes of several correspondents of the Question Department, who have asked for books of properties of steel sections and tables of strength of columns. The method of application of each of the tables is given in a few paragraphs. The tables of moments of inertia and radii of gyration give various combinations of two and four angles with each other, of one or two plates, of Z bars and plates, of channels, I beams, plates and angles, with many examples of such combinations to be found in buildings and bridges.

The data on unit strains in columns under compression are given in tabular and graphical form for all the standard formulæ, from Gordon's to that of the Committee on Iron and Steel Structures. The grades of steel, safe tensile stresses and formulæ for safe compression stresses prescribed in various specifications for railroad and highway bridges and buildings are also arranged in tabular form.

One set of tables gives the safe load on columns or struts of unbraced lengths of 4 to 30 feet with various weights, and cross-sections of combinations of angles, plates and channels, in various ways; also stresses due to weight of section.

Areas of plates, deductions for rivet holes of various sizes, in plates, angles, I beams, channels and cover plates are put in convenient form for use. The principles of the graphic design of plate girders are fully but briefly stated, and tables of moments of inertia of plates, cover plates and combinations of angles for use therewith are given.

Tables of breaking strength of timber, safe loads on timber columns and beams, thickness of wood flooring and bending moments close the book.

It will be found very useful as a saver of time in the class of problems of design of sections that it covers, which are those most commonly met by the engineer in structural work for buildings or steel girder bridges.

NATIONAL ASSOCIATION OF CEMENT USERS

The Milwaukee Convention.

The Milwaukee Convention of the National Association of Cement Users.

The information about attendance and exhibitors at the second convention of the National Association of Cement Users, to be held in Milwaukee, January 9, 10, 11 and 12, 1906, indicates that there will be many more at the convention than were present at the Indianapolis convention, and that the exhibits will be greater in number and more varied in character. Already the contracts for space very nearly equal the entire space occupied at Indianapolis, and a number of contracts will doubtless result from the inquiries on hand, in addition to those which are made after intending exhibitors reach the convention.

The local committee at Milwaukee has been having some difficulty with its contracts for convention facilities, and it has been necessary to change the arrangements heretofore announced in the circulars sent by the secretary. The convention sessions will be held in the West Side Turners' hall, which is a most excellent auditorium, capable of holding any number of members likely to be present. The lighter exhibits will be located in the same building, and there is ample space for all those which have already contracted for space, with opportunity for

additions. The heavier exhibits, including the concrete block machines, the mixers, gasoline engines, etc., will be located in the Freie Gemeinde hall, which is located on the same block. This building has capacity for all of this class of exhibits which are likely to come to the convention.

The headquarters have been moved, on the recommendation of the local committee, to the Republican hotel, which is on the same block as the halls, and is an excellent hotel. The building for the heavy exhibits is on the route from the headquarters to the convention hall, and all are easy of access from each other. The headquarters hotel is about two blocks from the city hall and the hotels in that neighborhood.

All the railroad passenger associations but the New England have granted the usual rate of one and one-third fares for the round trip, on the certificate plan. Tickets must be purchased to Milwaukee and a certificate on the prescribed form must be taken from the ticket agent when the ticket is bought. This certificate must be presented at the convention to the assistant secretary, where it will be validated by the railroad agent on payment of a fee of 25 cents, which the railroads require for this service, and will then enable the holder to purchase a return ticket to his place of starting at one-third the regular fare. Those coming from New England can procure their certificates at the points where they enter the territory of the Trunk Line Association, viz.: when they enter New York State.

Following is the program as it is now arranged in order of presentation to the convention:

Tuesday afternoon, Jan. 9—

Business session.
Papers by
Sanford E. Thompson on "Concrete Aggregates.
Edwin Thacher, subject not yet stated.
Committee report: Streets, sidewalks and floors.

Tuesday night—

President's address. Stereopticon.
Papers by
A. L. Johnson on "Steel for Reinforcement."
Ross F. Tucker on "Twenty Years of Experience in Concrete Construction."

Wednesday morning, Jan. 10—

Papers by
C. A. P. Turner on "Cement in Building Construction." Stereopticon.
Richard L. Humphrey on "Investigation of Cement Mortars and Concretes at St. Louis." Stereopticon.
R. W. Lesley, subject not yet stated.
Report of Committee on Art and Architecture by Chas. E. Watson, chairman, and possibly others.

Wednesday afternoon—

Business session, question box and topics.

Wednesday evening—

Papers by
Louis H. Gibson, architect, on "Cement Block Architecture."
S. M. Woodward, U. S. Dept. of Agriculture, on "The Use of Cement and Concrete for Farm Purposes." Stereopticon.
J. C. McClenahan on "Manufactured Stone."
Report of Committee on Concrete Blocks and Cement Products.

Thursday morning, Jan. 11—

Report of Committee on Machinery for Cement Users, W. W. Benson, chairman, with papers by
E. B. Kelley on "Concrete Mixers."
J. P. Sherer on "Air Tamping and Conveying Concrete Blocks."
J. F. Angell and others.
Paper by J. L. Mothershead on "Waterproofing."
Paper by E. D. Longcope on "Uses and Abuses of Cement."

Thursday afternoon—

Papers by
O. U. Miracle on "Causes of Failures in the Concrete Block Business."
Richard K. Meade on "The Choice of Cement for Concrete Blocks."
S. B. Newberry on "The Manufacture of Hollow Concrete Blocks."

Thursday evening (Milwaukee night)—

The Association will be the guests of the Milwaukee friends at the "Builders' Club," with speeches, illustrated talks, refreshments and all the entertainments of this large and prosperous organization.

Friday morning, Jan. 12—

Paper by
E. S. Larned on "Observations on the Testing and Use of Portland and Natural Cements."
Report of Committee on Testing of Cement and Cement Products, E. D. Boyer, chairman.
Report of Committee on Laws and Ordinances.

Friday afternoon—

Report of Committee on Fireproofing and Insurance, by Vice-Chairman E. T. Cairns.
Papers by
R. P. Miller on "Legislation Concerning the Use of Cement in New York City."
Will J. Scoutt on "Building Regulations of Concrete Blocks."

The final official circulars regarding the convention are issued almost simultaneously with this notice and contain the arrangements somewhat more in detail. They can be obtained on application to Charles Carroll Brown, secretary, 310 Commercial Club Building, Indianapolis, Ind.

SMOKE PREVENTION

Smoke and Its Abatement.*

By Prof. Chas. H. Benjamin, Cleveland, O.

The smoke nuisance has long been one of the bugbears of living in the middle West and is now rapidly becoming an important factor in the East.

The fact might as well be recognized at once that the supply of so-called smokeless fuels—anthracite coal, petroleum, natural gas, etc.—is limited and will not begin to satisfy the demand. The supply of bituminous coal, on the other hand, is practically unlimited, and it is doubtless the fuel of the future. The abundance of it, its cheapness and the readiness with which it burns, even with a poor draft, combine to make it a most desirable fuel. This granted, the further fact remains that it will be burned to a larger and larger extent in the East as well as in the West, and that no legislation can prevent this. Just as anthracite coal becomes more scarce and its price increases, just as surely will its place be taken by the cheaper and more abundant fuel.

The problem for our engineers and lawmakers is not how to prevent the burning of soft coal, but how to burn it in such a way that the combustion shall not be a public nuisance. The present discussion will then be confined to the problem of abating the smoke from bituminous coal. The word abatement is chosen with a reason, and the terms smoke prevention and smoke burning are discarded. It is not practicable to prevent the evil entirely, but only to mitigate it in a degree. Smoke burning, on the other hand, is an impossibility under the conditions which usually present themselves.

It will be well at the outset to state three propositions: (a) The smoke from bituminous coal is a nuisance, especially in large cities. (b) Such smoke can, in the majority of cases, be easily abated. (c) Such abatement can be made a source of profit to the owner of the plant as well as to the community. There need be no difficulty in establishing these propositions by precept and by example.

Objectionable black smoke is due to the presence of hydro-carbons in the fuel and is produced as follows: The hydrogen and carbon compounds in the coal are driven off as gas by the heat at a comparatively low temperature, and may escape unburned. In this condition they would not constitute smoke in the common sense of the term. If heated to a sufficiently high temperature in the presence of air they burn with a yellow flame. If the air supply is insufficient, is poorly mixed with gas, or if the temperature is lowered in any way, combustion is checked and carbon is deposited in the form of soot or carried off with the gas as smoke.

It is difficult to form any estimate of the amount of damage inflicted by soft-coal smoke in a city like Pittsburg or Cleveland, but it probably amounts to hundreds of thousands of dollars annually.

The abatement of smoke is in principle extremely simple, but presents some difficulties in the practical application. Only three conditions are necessary for complete combustion—the proper temperature, the proper air supply, a thorough mixing of the air and the hydro-carbons. The last condition is as important as any, and is one too often neglected. It is this condition which gives the gas or liquid hydro-carbon an advantage over the solid, since the atomizing of the former by the steam or air jet insures the most intimate contact between the air and the fuel. The use of pulverized coal in combination with air or steam is a close approximation to the above, and when properly managed, gives good combustion, no smoke and a high efficiency. The cost of pulverizing and the impracticability of storing pulverized fuel have so far hindered the more general adoption of this process, except for metallurgical work.

When coal, in the ordinary form, is used as fuel, smoke abatement involves some means of varying the coal supply and the air supply according to the demands made upon the boiler. When ordinary hand firing is resorted to the great irregularity of the coal supply will cause poor combustion and smoke unless the air supply is varied to correspond. Steam jets are freuently employed under these circumstances, and, if properly put in, will improve the combustion by drawing in additional air over the grate and mixing it with the products of combustion in front of the bridge wall. The steam jet should be semi-automatic, the steam and air being turned on by the opening of the fire door and gradually closed off by a dash-pot attachment.

The best solution of the smoke problem so far has come from the introduction of mechanical means of handling the coal, which give a uniform feed to the fuel and

*A paper before the American Society of Mechanical Engineers.

a corresponding delivery of air for combustion. The use of mechanical stokers has been brought about by the natural demand for machine handling in large power plants as more economical than human labor, rather than by a philanthropic desire to benefit the community.

Stokers may be divided into three principal classes—included, shaking grate (traveling or chain grates) and underfeed stokers. The inclined grate, as exemplified in the Wilkinson, Brightman and Roney stokers, has a hopper in front and slopes down and back, having a clinker grate just in front of the bridge wall, while the double incline, as in the Murphy and Detroit stokers, has a magazine on either side and slopes in two planes parallel to the axis of the boiler, meeting in a clinker grate at the bottom. The principle of action is practically the same and involves the slow coking of the coal on a dead-plate, the pushing forward on to the top of the incline and the gradual descent, impelled by oscillation of the grate bars, until the combustion has left nothing but ash and clinker at the bottom. Air is usually admitted both below and above the grate, and the hydro-carbons which are distilled at the top of the grates pass through the intense heat of the burning coke on their way to the bridge wall and are completely burned. The double incline usually has a revolving clinker bar, which disposes of some of the ash automatically, but as a rule both forms need considerable cleaning. When used with a fuel which does not cake or clinker too much and when not crowded too hard these stokers are economical and reduce the smoke considerably. If, however, it becomes necessary to slice and poke the fire on account of caking coal or overcrowded boilers, unburned masses of coal are rolled to the bottom and holes are made in the fire through which cold air rushes. Both of these circumstances make for poor combustion and a smoky fire. As a rule firemen poke the fire on stokers too much, doing more harm than good.

I have seen inclined grate stokers carrying a heavy fire and destroying much more than the rated capacity of the boiler with very little slicing and hardly a trace of smoke. Cleaning is usually a source of black smoke for a few minutes, but this is mostly unnecessary if the fireman understands his business and gets his fire ready for cleaning beforehand. I think the middle door in the Murphy furnace is sometimes a disadvantage, as it tempts the fireman to meddle with the fire when he had much better leave it alone.

The traveling or chain grate is rapidly coming into favor as a means of stoking automatically. It consists as in the Babcock & Wilson and Green stokers, of an endless horizontal chain running on sprocket wheels and carrying the coal back under the boiler, finally dumping the refuse over the back and into the ash-pit. The distilling process and the gradual burning of the coke are much the same as in the stokers just described. In order to prevent waste through the grates the latter are usually quite close, and it becomes necessary to use more draft than with ordinary grates. A damper is used underneath the grate to prevent an excess of air from passing up behind the grate. Some tests recently made by a large corporation which used a considerable number of the chain grates showed an evaporation of only 5.7 pounds of water per pound of coal. An examination disclosed the fact that a large excess of air was passing through the comparatively bare grate at the rear end. The introduction of a damper to regulate this brought about a great improvement. With the same fuel and same conditions as before an evaporation of 8 pounds of water per pound of coal was obtained. Intending users of chain grates would do well to bear this in mind. From observations covering a period of several years I have come to the conclusion that this type of grate is the best one yet devised for abating smoke. The fact that it is horizontal, so that unburned coal can not run to the rear end, and the further fact that it is self-cleaning and need not be disturbed by the slice bar, make it an almost ideal furnace in this respect. If run by an intelligent fireman who understands adapting the depth and travel of the fire to the work to be done, it will also be a very economical furnace.

The underfeed stokers operate on an entirely different principle, the coal being fed in underneath the grate and forced up through a rectangular opening in the center. A forced blast is used and the air for combustion is blown up through the coal, the tuyeres being on either side of the rectangular opening just mentioned. By this arrangement the fresh coal is always underneath and the distilled gases are obliged to pass through an incandescent mass of fuel in company with the air. With a proper pressure of blast perfect combustion is thus almost unavoidable. The ash and clinker are now at the top of the fuel, which forms a gradually rising mound in the center and pushes the clinker over to either side, whence it is removed by hooks through doors at the front. The heat generated is such that the ash generally melts and forms a sheet of clinker, which can be easily removed without disturbing the fire.

In the American stoker the coal is forced under the grate and up by a revolving screw, somewhat similar in shape to the ordinary gimlet-pointed lag screw. In the Jones underfeed stoker a plunger driven by steam operates to feed the coal. This plunger can be arranged to start and stop by hand or to run automatically. My experience has shown the underfeed stoker to be economical in operation and practically smokeless. A criticism frequently made in regard to mechanical stokers is that they will not respond quickly to sudden changes in the load, that it is difficult to keep a uniform steam pressure under such circumstances, and that for this reason they are not economical. There is some truth in this. It is easy to conceive of circumstances, especially in electric plants, under which it would be difficult to maintain a uniform steam pressure with either the oscillating or the traveling grate.

For regular fluctuation of load, as in electric lighting or railway power houses, the obvious remedy is the introduction of storage batteries and the provision for ample boiler reserve. Minor fluctuations can be taken care of by the fireman, unless they become too numerous or too violent. In the latter case the underfeed stoker with the plunger feed comes the nearest to satisfying the demand. With the power of instantly regulating the motion of the plunger and the pressure of the blast, it is thus possible to meet emergencies of this kind more promptly than by hand firing.

With the complaint sometimes made that stokers can not be forced I have no sympathy. With an ordinary inclined-grate stoker under a horizontal tubular boiler I have forced a boiler to 25 per cent. above its rating with practically no smoke and with an evaporation of over 8 pounds of water per pound of bituminous slack. It all depends upon the draft and upon the intelligence of the fireman. It may be stated as a general proposition that smoke abatement means economy in fuel consumption. The proof of this statement is extremely simple—fuel economy results from good combustion; good combustion is accompanied by little visible smoke.

It must be remembered that the converse is not necessarily true, for a smokeless chimney does not always mean good economy. An excess of air may insure entire oxidation of the combustible matter and at the same time so dilute the chimney gases as to cause serious waste of heat.

Whenever, for any sufficient reason, the stoker can not be introduced there are other devices which will mitigate the smoke nuisance considerably and also save fuel. The steam and air blast has already been mentioned. A recent improvement which promises well is the combination of steam jets at the bridge wall with oil vapor, creating an intense heat at that point and consuming the hydro-carbons as they pass through. The expenditure of oil is comparatively small and considerable economy is said to result.

Brick arches and baffle walls have also assisted in maintaining a high temperature and in properly mixing the gases. The use of a reverberatory furnace or outside oven, in which the coal and its gases are thoroughly burned before going to the boiler, is another satisfactory method of reducing smoke, and may be used with as well as without a stoker. In short, whatever produces good combustion abates smoke. In apartment houses and stores, where the boilers are used for heating only and the steam pressure is low, the use of fuels which are comparatively smokeless is about the only satisfactory solution.

If the use of such fuels is supplemented by intelligent and careful firing the results will be reasonably satisfactory.

Locomotive engines present an entirely new set of conditions, requiring treatment radically different from that accorded to stationary plants. Several mechanical stokers have been designed for use on locomotives, and one of these, at least, has been fairly successful. This application is still in the experimental stage, however, and it is too early to pronounce upon its future.

Most railroad companies have to rely entirely upon the skill of their firemen for abating the smoke nuisance within city limits, and some of them have made a great improvement in this respect. Regular and careful observations during the years 1900-01 on the railroads entering the city of Cleveland showed a reduction in the average amount of smoke emitted by locomotives of from one-half to two-thirds as a result of the so-called one-shovel system of firing, without any change in the furnace or equipment. The introduction of brick arches also proved to be a good investment.

In closing I wish to call attention briefly to the legal aspect of the question, although this may not interest engineers as much as does the scientific aspect.

I believe that the municipalities have a right to insist upon the abatement of black smoke by all users of steam boilers, without regard to the purposes for which the steam is used or the means to be adopted for abatement. This because smoke is a public nuisance and because it can be abated without hardship to the owner of the plant. Nevertheless, when

the evil is present and has been present for a period of years it is not good policy to be too radical in the enforcement of the statutes. The law should be definite and stringent and the penalties adequate, but they should be enforced with discretion by officials who have some technical and practical knowledge of smoke abatement.

It is absurd to talk of putting this matter into the hands of the police or of the health officer. The official having charge of this work should be a trained engineer, if possible a technically educated man, and he should be entirely above graft in any of its disguises.

When the public comes to realize its rights in this matter and that it is under no more obligation to submit to this nuisance than it is to endure bad drainage or filthy streets, laws will be enacted and enforced and the people will wonder that they so long submitted to this unreasonable imposition.

ORGANIZATIONS AND INDIVIDUALS

Indiana Engineering Society—Northwestern Cement Products Association—American Society for Testing Materials—Technical Meetings—Civil Service Examinations—Municipal Elections—Personal Notes.

The Indiana Engineering Society.

Under the efficient leadership of President R. P. Woods, of Indianapolis, the Indiana Engineering Society is taking on new life. As indicated by the programme, a part of which was printed in the December number of MUNICIPAL ENGINEERING, the professional work of the association is of high grade. Two additional papers are on a railroad plant for treating ties and on methods of computing haul and overhaul.

A trip has been arranged for Friday afternoon, January 19, over the new high-tension electric line between Indianapolis and Rushville, the only one of the same extent in successful operation. This will be in itself worth the trouble of attending the convention.

On Thursday evening, January 18, the society will hold its first banquet, at least for many years. The indications are for a large attendance, and the committee has provided a varied entertainment, including prominent speakers within and witnout the membership of the society, with monologues, vocal solos and orchestral music interspersed.

A large increase in the membership of the society is one of the results of the new life, and the association is becoming a full representative of the engineering profession in the State, including civil, mechanical, electrical and mining engineers, surveyors, engineering contractors, water-works, lighting, railroad and other superintendents.

The convention will be held at the Commercial Club, Indianapolis, beginning at 2 p. m. January 18, 1906, and the banquet will be held, probably at the Denison Hotel, on the evening of the first day. Charles C. Brown, Indianapolis, is secretary.

Northwestern Cement Products Association.

The second convention of the Northwestern Cement Products Association will be held in Mineapolis, January 17, 18 and 19, 1906. The convention held last year was a great success, and it is planned to make the coming one a still greater one. Committees have been appointed to look after all features of the convention, and the programme committee is already in a position to announce that the speakers will be among the ablest in the United States in their respective lines, and the topics will be those that will interest contractors, builders and cement men generally. The exhibit committee has already received a large number of applications for space, and as the convention occurs immediately after the national convention at Milwaukee most of the exhibits will be brought here from the latter city.

A cordial invitation to be present at the

convention is extended, and every courtesy possible will be extended by the association.

Data Regarding Tests of Fire-Proofing Wanted by the American Society for Testing Materials.

At a recent meeting of Committee P. on Fireproofing, of the American Society for Testing Materials, it was decided to consider for the present the establishing of a standard fire test for fireproof floors only. For this purpose the committee will endeavor to collect all available data on fire tests of fireproof floors and information resulting from the study of fires and conflagrations, more particularly as to the temperatures reached and the duration of same. It is proposed to analyze and study this information, then publish the same, with the hope of drawing forth suggestions and criticisms from all who may be interested.

It is the earnest desire of the committee to make the record of past tests as complete as possible, and it will greatly appreciate the kindness of those who may possess such information if they will take the trouble to forward the same to the committee. Such information may be sent to Prof. Ira H. Woolson, chairman of the committee, at Columbia University, or to the secretary, R. P. Miller, 141 copies of the reports cannot be forwarded reference to the journals in which the reports have appeared may be given.

Technical Meetings.

The twentieth annual convention of the National Brick Manufacturers' Association and the eighth annual meeting of the American Ceramic Society will be held at Philadelphia February 5 to 17.

The next convention of the Illinois Clayworkers' Association will be held at Champaign, Ill., January 23, 24 and 25. George Hartwell, secretary, Plymouth Building, Chicago.

The annual convention of the Michigan Engineering Society will be held at Lansing, January 9 and 10. F. Hodgman, secretary, Climax, Mich.

The annual meeting of the New England Water-works Association will be held at Boston, Mass., January 10. William Kent, secretary, Narrangansett Pier, R. I.

The annual meeting of the American Society of Civil Engineers will be held at 20 West 57th street, New York City, January 17 and 18. C. W. Hunt, secretary.

The annual convention of the Northwestern Cement Products Association will be held at Minneapolis, Minn., January 17, 18 and 19. F. H. Chapin, secretary, 10 N. Third street, Minneapolis.

The annual meeting of the Illinois Society of Engineers and Surveyors will be held at Rockford, Ill., January 17, 18 and 19. E. E. R. Tratman, secretary, 1636 Monadnock Building, Chicago.

The New York Electrical Society has arranged an attractive programme for the present season, including papers on "Electrical Reactions of Gases," by Peter Cooper Hewitt; "The Electrification of the Long Island Railroad," by O. S. Lyford, Jr.; "The Signal System of the New York Subways," by J. M. Waldron; "Ether Telegraphy," by Guglielmo Marconi; "News, Newspapers and the Telegraphic Art," by Melville E. Stone; "Two Thousand Years of the Steam Turbine," by C. G. Curtis; "The Place of the Electric Vehicle in Automobilism," by Robert McAllister Lloyd, and "The Single Phase Railway," by C. F. Scott.

The Concrete Block Machine Manufacturers' Association has published the proceedings of its convention in booklet form.

The Iowa Association of Cement Users will hold its second convention at Ames, Ia., February 8 and 9, 1906. An extensive programme is in preparation, with an exhibit of machinery and materials for cement users.

U. S. Civil Service Examinations.

Examinations will be held January 10, 1906, at the usual places, for engineer at Puyallup, Wash., at $600, at Colorado River Agency at $900, and at Grand Junction, Col., at $840, in the Indian service; also a general examination to fill future vacancies at $480 to $1,000 a year.

Municipal Elections in Washington.

City officials were elected in Washington, December 5, as follows:

Ballard—Mayor, J. H. Wiley.

Georgetown—Mayor, John Mueller.

Bellingham—Mayor, Alfred L. Black.

Everett—Mayor, J. H. Mitchell; clerk, — Wilson; treasurer, — Keay.

Auburn—Mayor, A. H. Mead, re-elected; J. B. Seavey and George Hart, councilmen; treasurer, E. R. Bissell.

Aberdeen—Mayor, John Lindstrom; city clerk, Peter Clark; treasurer, Roy Sargent.

Port Townsend—Mayor, Daniel H. Hill; treasurer, C. Lintermela; city clerk, Alphonso F. Learned.

North Yakima—Mayor, Walter J. Reed; city clerk, C. J. Brooker; treasurer, C. R. Donovan.

Hoquiam—Mayor, Dr. A. J. McIntyre;

clerk, — Wilson; treasurer, William B. Ogden.

Reardan—Mayor, H. Moriarty; treasurer, H. G. Burns.

Tekoa—Treasurer, R. B. Sells; council, L. J. Lauritzen, A. B. Willard, Charles Jaems, George Shuler.

Sprague—Mayor, C. L. Fish; clerk, J. F. Hall; treasurer, A. E. Holgate.

Wilbur—Council, L. Lewis, W. W. Howell; treasurer, Peter Faldborg.

Medicine Lake—Council, W. A. Harris, W. J. Titus, Rufus Woods.

Ellensburg — Mayor, W. Bartholet; treasurer, C. N. Stewart.

Pullman—Mayor, D. F. Staley, re-elected.

Spangle—Mayor, John Peters; council, H. H. Schaeffer, J. H. Grunewald, A. E. McMichael; treasurer, W. E. Hoxsey.

Rosalin—Council, T. E. Prichard, J. A. Anderson, Verne Towne; treasurer, W. W. Pickett.

Northport—Mayor, R. G. Field; city clerk, F. R. Robinson; treasurer, F. G. Slocum.

Dayton — Mayor, O. F. Jackson; city clerk, R. M. Sturtevant; treasurer, Walter W. Pary.

Colfax—Mayor, W. J. Davenport, re-elected.

Palouse—Mayor, J. K. McCornack; city clerk, G. G. Kincaid; treasurer, J. T. Follansby.

Clarkston—Mayor, Frank Brown; council, G. W. Ferguson, C. W. Huntin, S. T. Ramsey; treasurer, L. S. Lahm.

Wenatchee—Mayor, H. C. Littlefield; city clerk, A. A. Bosquet; treasurer, F. D. Case.

Roslyn—Mayor, W. P. Morgan; city clerk, Leonard Weber; treasurer, Anthony Stevens.

Centralia—Mayor, Charles S. Gilchrist; city clerk, W. O. Bennett; treasurer, P. R. Stahl.

Newport—Mayor, Dr. J. T. Phillips; treasurer, W. H. Krause.

Sumner—E. T. Guptil; treasurer, J. W. Bray.

Port Angeles—Mayor, P. J. Appleton; treasurer, C. E. Naylor; city clerk, E. E. Goodman.

Olympia—Mayor, P. H. Carlyon; clerk, Jas. R. Dever; treasurer, Theodore L. Brown.

Castle Rock—Council, P. S. Dickman, D. J. Hill, J. C. Gladwish.

Prosser—Mayor, E. W. B. Taylor.

Snohomish—Mayor, — LaForge; city clerk, James Burton; treasurer, W. M. Snyder.

Almira—Mayor, Julius C. Johnson; council, N. O. McKee, C. M. Phillips, W. A. Mitchell, M. C. Salter, W. L. Reeves.

Ritzville—Mayor, Fred Thiel; treasurer, A. H. Albert.

Davenport—Mayor, E. E. Lucas; treasurer, J. A. Hoople; city clerk, Leo Odgers.

Garfield — Mayor, Sheridan McClure; treasurer, H. D. Irwin.

Elberton—Mayor, C. A. Parker; council, S. Johnson, W. W. Renfrew, P. Easterbrook; treasurer, George Penn.

Odessa—Council, R. E. Trantum, O. F. Minch, W. L. Smith, Fielden Legsdon; treasurer, Joseph Kriegler.

Harrington—Council, J. J. Cameron, Harry Ochs; treasurer, John Weisgerberg.

Asotin—Council, J. R. Jones, K. L. Thompson, M. D. Loon; treasurer, — Mathews.

Chelan—City treasurer, C. J. Crow; council, H. B. Higgins, T. W. Green.

Cosmopolia—Mayor, A. G. Wellington; treasurer, D. F. Speigle; council, H. Breakiron, I. M. Smith.

Sunnyside—Mayor, W. B. Bridgman; council, W. B. Cloud, E. J. Young, James Henderson, Dr. J. G. Campbell.

Pasco—Mayor, J. McIntyre; council, W. J. Gilroy, Roy J. Hytson; city clerk, S. O'Brien.

Cle Elum—Mayor, R. E. Kernen.

Rockford—Mayor, Dr. G. M. Gould; treasurer, H. W. Collins; council, Jacob Kindshup, A. C. Stringham, Jacob Hanson.

Springdale—Council, William Taylor, — Boyles, — Ketchum, — Smith, — Forney; treasurer, — Cline.

Waterville—Mayor, M. B. Howe; council, Geo. W. Hollinghead, R. W. Starr, F. E. Weston; treasurer, A. R. Dickson.

Personal Notes.

Thomas Sharpe was elected mayor at Winnipeg, Manitoba, December 12.

E. L. Beach has been elected mayor at Chenoa, Ill., to succeed the late Charles Nickel.

John F. Fitzgerald, former Congressman, was elected mayor at Boston, Mass., December 12.

Louis Meyer has been appointed city engineer, and John P. Keller street commissioner, at Boonville, Ind.

William Charles Durkee, city treasurer at Mankato, Minn., died December 14, of Bright's disease, aged 29 years.

W. B. Bates, of Richmond, has been elected city engineer of Roanoke, Va., succeeding Capt. J. H. Wingate, resigned.

Robert Moore has been appointed consulting engineer of the Municipal Bridge and Terminal Commission, at St. Louis.

J. H. Fraser has been elected mayor, and W. H. Andrews, C. B. Colbert, A. Harvey and George A. Doyle, aldermen, at Georgetown, S. C.

Dr. Ferdinand's election as mayor of Cliffside Park Borough, N. J., has been sustained by Justice Garretson, of the New Jersey Supreme Court.

Winfield Scott De Hart, vice-president of the Colonial Construction Company, New York City, died sudenly December 14, of pneumonia, aged 54 years.

J. E. Robinson, of Deshler, Ohio, one of the oldest brick and tile manufacturers in the State of Ohio, died suddenly of heart failure recently, aged 78 years.

Desmond Dunne has been appointed commissioner of public works for the borough of Brooklyn, New York city, by Bird S. Coler, recently elected president of that borough.

Arthur Newhall Johnson, Assoc. M. Am. Soc. C. E., of the U. S. Public Roads office, has been appointed by the Illinois Highway Commission as State Highway Engineer of Illinois.

Major John Biddle has been retained in the office of Engineer Commissioner in the District of Columbia until the completion of certain important engineering works on which he is engaged.

Robert P. King has resigned his position as the smoke inspector of Indianapolis and resumed his practice as consulting

and erecting engineer with Brossmann & King, Lemcke Building, Indianapolis.

Gabriel Leverich died in Brooklyn recently. He was widely known among the older members of the American Society of Civil Engineers on account of serving for six years as its secretary, his term expiring in 1877.

Amos L. Schaeffer, Assoc. M. Am. Soc. C. E., senior assistant engineer of the sewer division of the Rapid Transit Railroad Commission, New York City, has been advanced to the position of division engineer, succeeding Calvin W. Hendrick, resigned.

Henry S. Pritchett, who has for five years been president of the Massachusetts Institute of Technology, has resigned his position to devote his entire time to his new position as president of the Carnegie Foundation Fund for pensioning aged and needy professors.

Hugo Diemer, M. A. S. M. E., recently with the Atlas Engine Works, has opened an office at 310 Commercial Club Building, Indianapolis, as a production engineer, and issues a booklet explaining what field is covered by this comparatively new subdivision of the engineering field.

T. C. Phillips, of the city engineering department of Chicago, has been assigned to special work in connection with the extension of the water mains. His former duties as supervisor of the operation of pumping stations will be taken by William J. Burns, now chief engineer of the East Chicago-avenue station.

William T. Hunt, of Newark and Chatham, resigned, December 4, as a member of the State Sewerage Commission, on account of important business duties that will not permit him to devote to his duties on the commission the time and attention which that position requires. His resignation will take effect January 7, 1906.

Verne L. Havens, Jun. Am. Soc. C. E., has resigned as principal assistant engineer of the Tri-State Land Company canal of Scott's Bluff, Neb., and has accepted a position as assistant engineer with the Mexican Light and Power Company, of Necaxa, Puebla, Mex. T. M. Donelson succeeds Mr. Havens as engineer in charge of construction work at Scott's Bluff.

Michael O'Connor, one of the best-known bridge builders in the United States, died at Hartford, Conn., December 19, aged 66 years. Mr. O'Connor built the twenty-nine stone piers of the Louisville bridge which spans the Ohio river at the falls, and while in partnership with Joseph McCulloch the firm built the bridge across the Ohio river at Henderson, Ky., for the Louisville & Nashville railroad. Mr. O'Connor also built bridges in Ireland, Scotland and Australia.

General Herman Haupt died suddenly December 14 on a Pennsylvania railroad train leaving Jersey City for Washington. General Haupt was one of the oldest civil engineers in the United States. Advanced age is the cause assigned for his death. He was born in Philadelphia, March, 26, 1817. He was graduated from the Military Academy at West Point in 1835, but resigned in October of the same year to enter the practice of civil engineering. In 1844-47 he was professor of civil engineering in the Pennsylvania College. He filled many important positions from that time on. General Haupt was one of the first among Americans to discuss the theory of stresses in framed strtucures, and in 1852 he published his "General Theory of Bridges." Among other publications of General Haupt are "Military Bridges," 1863; "City and Suburban Motors," 1893; "Reminiscences of Gen. Herman Haupt," 1892. At the time of his death, General Haupt was accompanied by his son, Prof. Lewis M. Haupt, formerly a member of both the Nicaraguan and Panama Canal Commissions.

MACHINERY AND TRADE

Wall Plugs in Concrete Construction.

Anyone familiar with the methods of concrete block construction readily recognizes the extreme difficulty of attaching the interior finish unless provision has been made for this while the building is under construction. This provision, up to the present time, has largely been in placing wooden strips in the mortar joints. This method, however, is most faulty and unreliable. It is practically impossible, also, to nail directly into the joints after the cement sets. The use of the Rutty Metal Wall Plugs overcomes these difficulties. The plug is made of heavy sheet steel, so formed that the opening is left sufficiently large for the insertion of 10-penny and even larger nails at any time. The plug is placed in the wall as it is being built, taking no time whatever, and if the interior finish is not put in for a year later the opening is still there to receive the nail.

This method is now coming into very general use among concrete block builders, the majority of whom declare the plug to be practically indispensable in this form of construction. The cost is insignificant, and the time saved over any other method is very soon apparent. The plug is practically indestructible, being thoroughly japanned. Galvanized plugs can also be furnished when desired.

Messrs. J. B. Prescott & Son, of Webster, Mass., are the sole patentees and manufacturers, and will be pleased to submit samples, descriptive matter and terms on request.

Rapid Development of Cement-Block Trade.

The Wichita Coal and Material Co. says its experience is limited to about six months, but it finds a great demand for the cement-block product. It started in with a small plant, with the idea of making it a side issue during the lull in the coal business, but has never been able to fill all orders. Orders were turned

AMERICAN CONCRETE MIXER ON TRUCKS WITH STEAM ENGINE AND BOILER—DISCHARGING POSITION.

away not only by them, but by the five other cement-stone factories in Wichita. This demand in excess of the output at this time is also not attributable to cold weather, as the three largest plants in the city have installed heating apparatus and have been running every day to their full capacity.

They are installing a large mixer of their own make, increasing the capacity of the dryhouse, and within two weeks will have five times their former capacity, and instead of being a side issue to the coal business, that is becoming a side issue to the stone business.

This heavy demand has had the effect of lessening the competition and encouraging manufacture of a good quality of stone, which has done more for the good of the cause than any effort the operators could have put forth.

There was the usual amount of prejudice, but now there is very little natural stone used, although Wichita is only twenty miles from large quarries, which produce a fine quality of building stone.

They have also put in a factory for the manufacture of the Reed cement-block and brick machines, and find that the demand for these machines is almost as much in excess of the output as is the demand for stone. They are increasing their factory for manufacturing machines, so as to be in shape to take care of all orders. Machines are being shipped to all parts of the country, the last shipment being made on a telegraph order from California.

They have under construction a concrete mixer for which they make large claims, as this machine, with the slight assistance of one man, will operate itself, mixing two batches at the same time. Machines will be made to handle as large batches as desired or as small as required by the trade, without the use of machinery power.

The prospect for buildings to be erected in this section of the country during 1906 is the best, and it is expected that the development will exceed any year of the past.

Steel-Bound Concrete Curb.

The Steel Protected Concrete Company reports large use of its steel-bound concrete curb, which it attributes to its proven durability and economy and its fine appearance. Nearly one million linear feet of this curb has been laid within the past three years. New Orleans has put in over 25 miles in two years. Greater New York has been using the curb for years and has laid over 20 miles in 1905. Philadelphia has specified over 50 miles of the curb for the new boulevards. Baltimore is using it extensively in place of granite. Many other cities are using it on their most prominent streets.

The claim is made that in all these places it has proved superior to the best granite curb in durability and appearance, at less first cost.

Waterproofing for Walls and Foundations.

The Sicilian Asphalt Paving Co., 41 Park Row, New York, have developed a system of applying waterproofing to subterranean structures, which can be applied to wet or dry surfaces, as the waterproofing materials are applied cold. A textile fabric is saturated and slightly coated at the factory with a certain compound of asphalt. This fabric is applied to the surface to be waterproofed, whatever may be its position. An amalgamating solution is then applied, then another

layer of fabric, and so on to any desired thickness. The resultant mass acts as one layer and adjusts itself to any movements of the mass of the foundation, thus keeping it permanently waterproof. The material is put on the market under the name Carboron Cold Waterproofing.

A New Dump-Wagon Bed.

The Everett portable gravel-dumping wagon bed can be used on any gear wagon and dumps above the reach at the same time that it protects it. It will haul anything, from fine sand to large stones, and spread them along the road or dump in one heap, as desired. One hand to drive the team and one foot to dump the load are all that are required.

The construction is simple and strong, and therefore durable.

AMERICAN CONCRETE MIXER ON TRUCKS WITH GASOLINE ENGINE.

Concrete Mixers.

The prospective purchaser of a concrete mixer has long been confronted with the perplexing question, "Which is the best for my purpose?" Doubtless he realizes that a machine might give perfect satisfaction when mixing coarse, wet concrete, but if called upon to mix material for concrete blocks or work of similar nature it will be entirely unsuitable, if not a complete failure.

It is generally understood that concrete mixers are divided into two classes—viz., continuous and batch mixers. This is an erroneous impression, however, for batch mixers in themselves should be divided into at least two classes—those having a revolving drum, which rotates continuously, while others have stationary drums, in which the mixing is accomplished. A batch mixer affords greater certainty as to the proportion of each material used, and it is possible to confine the charge for a length of time sufficient to insure its uniformity. The batch mixers having the revolving drum, while differing in appearance, all operate and mix by practically the same principle. Some are constructed without "insides," while others are fitted with blades attached to the drum. In selecting a machine care should be taken to obtain one that will not cause the concrete to "pail" or clod if using other than a wet mixture, and, furthermore, one which will not tend to separate the materials in discharging a wet mixture.

From the foregoing it will be seen that the intending purchaser might well be perplexed if his work demanded a machine which could be used advantageously on all classes of concrete work. The batch mixer having a stationary drum, it is claimed, has solved this problem, however, and the accompanying cuts clearly illustrate a machine which operates on a distinctly different principle, lifting and turning the charge instead of rolling or shaking it together. By this method there can be no uncertainty of proportions; there can be no clodding or rolling of the materials and no clogging of the machine. The peculiar method of discharging eliminates all possibility of separation of the fine and coarse materials when discharging either a wet or a dry mixture. A series of revolving plows do the work most effectually, and the charge is mixed from 48 to 60 times per minute, whether it

be of wet or dry, of fine or coarse materials. The American Concrete Mixer most certainly appeals to the practical concrete man as one that is fitted for all classes of concrete work. While this machine was placed on the market only one year ago, it has met with great success, and users are enthusiastic as to its merits.

AMERICAN CONCRETE MIXER ON SKIDS WITH GASOLINE ENGINE HOUSED.

Concrete for House Building.

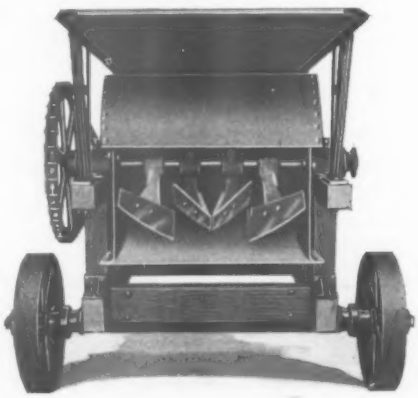
The application of concrete in the form of concrete blocks to the construction of houses has grown remarkably in the scant five years that practically represent its age. To all it offers its advantages of durability, strength, ease of manipulation, solidity, cheapness, freedom from repair and marvelous artistic capabilities. At one extreme we find the stately and magnificent country house, designed and built of concrete because, perhaps, more of the owner's little ideas and desires could be expressed for the slight difference in cost in its favor, perhaps because the almost total saving of heavy insurance bills was an item. At the other extreme lie row after row of comfortable cottages for workmen, which are going up near all of our large cities. The experimental age is passing—these are the facts, readily determined by what has actually occurred. The use of concrete is gaining ground from day to day.

We have been referring to houses built of blocks of concrete. Monolithic concrete construction, in certain lines particularly, presents advantages of its own.

A word as to comparative costs. Local conditions are variable: conditions a few miles apart may add or subtract some cents from the cost of each individual block. The variation is so great as to render any attempted universal estimate not only absolutely worthless, but ridiculous as well. We have seen localities where good concrete blocks could not be laid in the wall for less than brick. In general, however, a perfect block should make a saving over brick or cut stone. There have been instances mentioned where houses were built of concrete blocks at a less cost than even frame construction permitted. These instances are apt to become more numerous as the price of lumber increases.

Much prejudice against concrete for house building exists. We find it principally due to the two great causes—poorly made blocks and poorly designed houses. In the East must be added the conservatism of this section of the country to any innovation. In the first place, good blocks, which will stand up as well as stone in any climatic conditions and not absorb water, can be made, are being made. Good materials are absolutely necessary. These must include clean, sharp sand, not round, loamy sand—or, better, stone screenings—and a first-class grade of cement. The mixture must be exactly made, after long tests and study, and infinite care must be taken during every stage of the process, as well as during subsequent handling.

We now turn to the architectural side of the controversy. A great deal has been said regarding the inartistic properties of concrete, both in monolithic and block form. Many equally hideous houses are built of other materials. If architects had devoted as much of their attention and study to concrete as they have to brick and stone the results would have been entirely different. Good architects, who understand and have made a study of the medium, are absolutely necessary to attain artistic results, and they can be obtained.



AMERICAN CONCRETE MIXER. DISCHARGING POSITION VIEW OF MIXING PLOWS.

The first houses of concrete blocks were built with rough faces, in imitation of

roughly cut stone. No more inartistic medium could be readily imagined. They were, in fact, artificial or imitation stone houses, and poor imitations at that. Fortunately for the normal growth of the industry, this practice is dying out daily. Concrete is concrete; it is not artificial stone, and never will be.

Concrete as concrete is a wonderfully plastic medium of architectural expression. Countless effects are being designed every day which can be obtained with no other medium. New styles are being evolved whose artistic qualities are being recognized by the most discriminating of builders. These styles are stately, substantial, severe; at other times graceful, but unnamed. No half-hearted imitation of something already existing, but a branching out along lines utterly new and distinct—in this lies the salvation of the concrete industry.

Mention should also be made of the splendid opportunities given by concrete in the building of houses in the Spanish Mission style, with an interior "patio." In concrete they can be built at a moderate cost, and are suited to any climate, and will without doubt be extensively built throughout the country. All of the various Spanish Mission styles are, in fact, readily adapted to concrete construction.

Another legitimate field for the use of concrete blocks in a thoroughly artistic manner is to utilize them, merely as a cheapening construction material, in building English half-timbered, colonial or other desired styles of architecture. In this latter case the wall of concrete blocks is entirely subservient to the general architectural effect rather than a part of it. Here it serves merely as a material, not as a vehicle of expression, and opens up a wide field for cheaper houses of any of these styles.

Attention should be called to the excellent opportunity given by this material for uniformity in the carrying out of an entire suburban or country plan. In stable construction as many, if not more, advantages are offered than in house building. Gateways, staircases, garden walls, pergolas can all be worked out to correspond with the general scheme, where otherwise homely frame structures might be built.

No matter what kind of a home is in mind, from a $1,500 cottage up, no matter what cost or the conditions may be, concrete offers, under careful supervision and architectural planning, the same advantages, a saving in first cost, repairs and insurance, flexibility, strength, comfort and great artistic beauty.

AN OLD ENGLISH COTTAGE, SEVEN ROOMS, THAT CAN BE BUILT FOR $2,500. SPECIALLY ADAPTED FOR CONCRETE CONSTRUCTION.

The accompanying drawing shows a design of a cottage in old English style, which can be built in concrete for $2,500. It has been built by the Philadelphia Concrete Co., 420 Land Title Building, Philadelphia, Pa.

The Way to Milwaukee.

Every one going to the Milwaukee convention of the National Association of Cement Users, to be held January 9 to 12, will be able to use "the best of everything" in railroad practice on the Chicago & Northwestern railway. Those from the West and Northwest can use its lines for a large share of their journey, and those from every other direction can use the line from Chicago to Milwaukee.

A special train for the convention is announced to leave Chicago from the Northwestern Depot at 9 o'clock on Tues-

day morning, January 9, 1906, and to arrive at Milwaukee at 11 o'clock, in ample time to secure hotel accommodations and to register at the convention hall before the first session, which begins at 3 p. m.

Other trains leave Chicago about once in two hours all day, so that the convenience of all can be suited.

The Northwest Cement Products Convention will be held at Minneapolis January 15 to 18, and the Chicago & Northwestern railway offers the best of service from the one convention to the other.

be at the Milwaukee convention of the National Association of Cement Users to explain its operation and results.

Paris (Ky.) Has a Bituminous Macadam Pavement.

The *Bourbon News*, of Paris, Ky., has a complimentary notice of the pavement recently completed on Main street, in that city, by the National Bitumen Company of Indianapolis, accompanying the notice of the acceptance of and payment

CONCRETE VENEER FOR DWELLINGS.

A Concrete Block Veneer.

The accompanying photograph shows a house built by the Concrete Stone and Sand Company of Youngstown, O., which is veneered by their veneer block process. The style is broken ashlar, and the veneer can be made eight square feet at a time, the eight feet showing twelve blocks, no two of the same size. The photograph shows for itself and gives a very good idea of the quality of the work.

Waterproofing for Blocks.

The Sanitary Chemical Co. of Indianapolis, Ind., is just placing on the market a new material for waterproofing concrete, and Mr. G. G. Fry, of the company, will

for the pavement by the street committee.

A New Electric Plant.

The new plant of the Wisconsin Light and Power Company, which was recently completed at La Crosse, Wisconsin, began operation November 22. The plant is declared, by expert electrical engineers, to be one of the finest in the country. Ground for the plant was broken April 10, after which a delay of two weeks occurred on account of floods, and in June another delay of two weeks on account of heavy rains occurred. The completion of the plant in such short time is, therefore, looked upon as marvelous.

The entire plant was designed by Jacob

Cloos, consulting engineer of Milwaukee, assisted by Charles H. Williams, who is general manager of the plant. The installation of the plant was also under the supervision of Mr. Cloos, assisted by Mr. Williams.

Trade Publications.

The National Lime Manufacturers' Association has recently published the paper which received the $100 prize for the best paper on "Lime vs. Gypsum Plaster." It is by R. S. Edwards. Charles Warner, of Wilmington, Del., is president of the association.

Dallas (Tex.) has a 250,000 Club, which is distributing literature intended to influence an increase in population to this point by 1910.

The U. S. Cement Shingle Machinery Co., Saginaw, Mich., issues an excellent catalogue showing the use made of shingles made on its machines and giving some expressions of satisfaction with them by those who have had experience with them.

A recent publication of the National Board of Fire Underwriters contains the revised list of electrical fittings that have been approved by the Underwrtiers' National Electric Association. Another gives the requirements for sprinkler equipments.

The "Clinton Chronicle" for November illustrates in detail the various uses of the Clinton fireproofing and concrete reinforcing systems in the new power house of the Baltimore Electric Co., Baltimore, Md.

The Association of American Portland Cement Manufacturers has for distribution a number of copies of its pamphlet on "Concrete Construction," as well as of other publications which it issues at frequent intervals.

The Prescott corner bead, for use in plastering on wood, brick, terra cotta or steel construction, is explained in a circular issued by J. B. Prescott & Son, Webster, Mass.

Trade Notes.

BRICK.

Wellsville, O.—The Vulcan Clay and Brick Co. has been incorporated by Gustav J. Cohn, Julius A. Cohn, Frank McIlvaine, S. H. Hale, P. M. Smith and W. A. Sneidiker.

Moberly, Mo. — Meek Bros. Vitrified Brick Co. has been organized here and will erect a modern brick plant.

Saxton, Pa. — The Saxton Vitrified Brick Co. has been organized here, with S. B. Toler as treasurer. Directors: P. A. Barnett, I. K. Little, D. M. Stoler, C. O. Miller and John Heffner.

Dover, Del.—The Standard Brick and Tile Co., of Baltimore, has been incorporated here to manufacture bricks, tile and all clay products, by Edward J. Bond, Joseph R. Willson, S. M. Grayson and Wm. T. Morgan, all of Baltimore, and Harry W. Davis, of Wilmington.

CEMENT.

Chicago, Ill.—The Marquette Cement Mrg. Co. has increased its capital stock from $150,000 to $350,000.

Cumberland, Md. — The plant of the Cumberland Hydraulic Cement and Mfg. Co., after an idleness of nearly two years, will resume operation about January 1, with 150 men at work.

Tacoma, Wash. — The Pacific Coast Gypsum Co. has begun active preparations toward building its plant.

Roswell, N. M.—A large cement plant is being built and will be put in operation by January 1, on the Pecos river, near this city. The Acme Cement Co., which has five mills—one at Laramie, Wyo., one at Grand Rapids, Mich., two in Indian Territory and one at Acme, Tex.—is building the plant.

Sandusky, O.—The county commissioners have granted a franchise to the Sandusky Portland Cement Co. to cross the Mustcash road with a railroad. The company is developing more marl land several miles from its plant and finds it necessary to extend its railway.

Minneapolis, Minn.—The Tinius Olsen Co., of Philadelphia, was awarded the contract for a cement testing machine for this city.

Brazil, Ind. — The Western Fire Cement Co. has been incorporated by Lewis McNutt, B. S. McNutt and Charles McConnell.

Charlestown, Ind.—The Standard Cement Co. has engaged an expert to make experiments with a view to manufacturing Portland cement.

CONCRETE BLOCKS.

Toledo, O.—The Yarnell Concrete Machinery Co. has been incorporated by Ithamer E. Yarnell, Christian J. Nachtrieb, Rupert Holland, L. I. Yarnell and E. W. Sawhill. The company is a reorganization of the I. E. Yarnell Company, which makes a machine for the manufacture of concrete blocks, sills, coping, etc.

Redding, Cal.—Joe Clinkenbeard and Jack Kaveny have purchased a Miles concrete block machine, which is manufactured by the P. B. Miles Mfg. Co., of Jackson, Mich.

Des Moines, Ia.—Henry Schee is preparing to open a factory for the manufacture of a detachable concrete block press. The device can be attached to the side of a frame building, the desired block of cement for veneering molded in it and the machine then detached, so that the work of molding is done on the side of the building instead of molding the blocks on the ground and then building up the wall afterward.

Plain City, O.—The Winget Concrete Machine Co. has been incorporated to manufacture products out of clay, cement and wood. The incorporators are Howard C. Black, J. F. Angell, J. M. McDowell, J. P. Black and John A. McDowell.

Westwood, N. J.—The Westwood Concrete Block Co. has been incorporated to manufacture cement building blocks, by John B. Speth, Joseph Cooper and Abraham B. Bogert, of this city.

Sumter, S. C. — The Sumter Cement Block Co. has been incorporated by W. A. Weathers, F. N. Tryon and J. J. Whilden.

Philadelphia, Pa. — Walter L. Webb, Land Title Bldg., has made a sale of 125 tons of Johnson corrugated bars for

reinforced concrete work on the Juniata Hydro-Electric Co., for erecting a reinforced concrete dam at Petersburg, Pa.

Camden, N. J.—The Columbian Reinforced Concrete Co. has been incorporated to do general concrete, pipe and conduit work, by John A. MacPeak, Geo. H. B. Maryin and F. R. Hansell.

Madison, Minn.—C. J. Bloom has purchased the cement block and tile factory of Olson & Carson.

Waterloo, Ia.—The Waterloo Concrete Brick and Block Machine Co. has recently installed machines at Carthage, Ill.; Johnsburg, Ill.; Seattle, Wash.; Cordelle, Ga.; Colonial Beach, Va.

Seattle, Wash.—The Puget Sound Portland Cement Co. has been organized, with John A. Soderberg, of Index, Wash., as president and general manager.

Aberdeen, S. D.—D. S. Culbert has engaged in the manufacture of cement blocks.

New Richland, Minn.—W. F. Rourk will engage in the manufacture of cement sidewalk flags.

Little Falls, Minn.—G. V. Clark, of this city, contemplates removing his cement block plant to Donnybrook or Kenmare, N. D.

Perham, Minn.—A plant is being erected here by —— Pinch for the manufacture of cement building blocks.

Oshkosh, Wis.—The Molded Concrete Machinery Co., of this city, will soon engage in the manufacture of machinery. The officers of the company are: President, C. W. George Everhart; vice-president, A. S. Holmes; treasurer, Samuel B. Everhart, Berlin, Mich.; secretary, G. T. Moore; general manager, J. F. Kern; superintendent, Charles G. Dauber; mechanical engineer, W. H. Kratsch. The company has established branch offices in New York, San Francisco, Seattle and London.

New York City.—The United States Concrete Machinery Co. has been incorporated to deal in concrete, etc., as follows: President, W. H. Larkin, Jr., 12 Grandview ave., Somerville, Mass.; treasurer and clerk, Leonard Goodwin, Main st., Concord, Mass.

Camden, N. J.—The American Vitreous Co. has been incorporated to deal in brick, stone, cement and other building materials, by Arthur M. Hay, Charles B. Rockwell and Herbert J. Rockwell.

Crawfordsville, Ind.—W. O. Emery has been granted letters patent for "Aging Portland Cement," No. 806,788. Claim: The art of aging Portland cement, which consists in spraying the heated clinker with a dilute carbonate or bicarbonate solution, and in afterward exposing the freshly ground cement to the action of gases containing a large percentage of carbonic acid. The improvement in the art of aging Portland cement, which consists in spraying the heated clinker with a dilute solution of ammonium bicarbonate. The improvement in the art of aging Portland cement, which consists of spraying the heated clinker with a dilute solution of ammonium bicarbonate and in the introduction of stack or kiln gases into the conveyor which carries the freshly ground cement away from the grinding apparatus.

Washington, D. C.—Special.—H. S. Palmer, of the Harmon S. Palmer Hollow Concrete Block Co., advises us that he has sold exclusive rights to his system in Lackawanna county, Pennsylvania, and three machines, one of which was purchased by A. T. Troutwine, of the Carbondale Machine Works, Carbondale, Pa. He also sold rights to Camden county, New Jersey, and two machines to George A. Aldrich, of Philadelphia.

Kansas City, Mo.—Special.—The A. J. Middleton & Son Construction Co. says they have been successful in securing four good contracts for reinforced building here, one for $50,000, one for $25,000 and two smaller ones. It is believed that in another year there will be a great amount of work constructed here.

Newark, N. Y.—Special.—Bloomer Bros. Co., Inc., advises us that it owns a complete plant for the manufacture of hollow concrete blocks, brick, etc., which is for sale for $15,000. The company states that if it could sell its paper-box factory it would not sell the concrete plant at any price, but it is hard to find a purchaser for the paper-box factory, owing to the fact that they have invested about $75,000 in the business. R. A. S. Bloomer, sec. and treas.

Toledo, O.—Ithaner E. Yarnell has been granted a patent on a concrete block machine. A company has been incorporated and is now manufacturing the machines, by Ithaner E. Yarnell, C. J. Nachtrict, Rupert Holland, L. I. Yarnell and E. W. Lawhill.

Detroit, Mich.—The Detroit Concrete Stone Co. has been incorporated by Hugh Wallace, D. D. Wessels, and F. H. Zeigen.

Detroit, Mich.—The Great Lakes Cement Machinery Co. has been incorporated by R. R. Bane, F. H. Zeigen, and W. R. Chapman.

PROPOSED PURCHASE OF MACHINERY.

Tacoma, Wash. — Special. — Lewis C. Hall & Co., 220 Washington Bldg., desires catalogues and descriptive matter regarding trenching machines.

Sherbrooke, Que. — Special. — Thomas Trembley, cy. engr., advises us that he desires to purchase flushing tanks to be used to flush main sewers on a separate system of sewerage.

Pentwater, Mich.—Special.—F. F. Wetmore advises us that he is preparing plans and specifications for 3,000 to 5,000 ft. of 12 and 18-in. sewers for this village and desires prices on round and egg-shaped sewer pipe, manhole covers, traps, trench jacks or braces, etc.

Sheffield, Ala.—Special.—A. D. Thomson, Box 31, desires to purchase concrete building block machinery, etc.

Battle Creek, Mich.—Special.—C. Walter Stendell, of Union Steam Pump Co., desires to purchase all tools pertaining to cement.

Suffern, N. Y.—Special.—J. B. Schutt is in the market for a concrete mixer for making concrete blocks.

Long Beach, Cal. — Special. — G. van Hauten, 654 Cedar ave., advises that he desires to purchase tools and machinery for general building.

Montgomery, Ala. — Special. — E. E. Price, Box 417, is in the market for cement or steel working tools.

Miami, Fla.—Special.—F. Rutter advises us that he desires to purchase a steam rock drill and dipper dredge to be used on land.

Sacramento, Cal.—Special.—A. Clark, State House Hotel, is in the market for asphalt plants and concrete mixers.

Everett, Mass.—Special.—John D. Henderson, supt. sts., advises us that he may purchase a stone crusher in the spring.

Caldwell, Ida.—Special.—Lem Harding desires to purchase a concrete mixer.

Grand Rapids, Mich.—Special.—C. E. Williams genl. contr. in cement work, advises us that he is in the market for a post nad block machine and for a second-hand mixer.

Chicago, Ill.—Special.—J. J. Flanders, room 402, 80 Dearborn st., desires to purchase concrete mixers of limited capacity—10 to 20 yds. a day, hand or power.

Middleboro, Mass.—Special.—John C. Chase, 3 Maple ave., supt. of sts., says that city is talking some of purchasing a mixer.

Farmersburg, Ind.—Special.—James A. Dodd advises us that he is in the market for machinery and tools for making concrete blocks and bricks.

Clay Center, Kan.—Special.—Wm. B. Evans, st. comr., says he is in the market for road graders, wheel scrapers, machinery and tools for making steps, and cement workers' tools.

Greenville, Tex.—Special.—Manco Shepherd advises us that he is in the market for a concrete mixer and cement tools.

Hamilton, Ill.—Special.—Geo. B. Barber writes us that he desires to purchase concrete tools.

New London, Conn.—Special.—H. E. Rogers advises that he is in the market for a batch mixer.

Rushville, Ind.—Special.—Clarence Carney advises us that he desires to purchase machinery and tools for building blocks, posts, bridges, etc.

PURCHASE OF MATERIALS.

Montgomery, Ala. — Special. — E. E. Price, Box 417, advises us that he is in the market for cement and steel.

Nanticoke, Pa.—Special.—Philip Letcher desires to purchase cement and plastering.

Long Beach, Cal. — Special. — G. van Hauten, 654 Cedar ave., advises us that he is in the market for materials for building.

Suffern, N. Y.—Special.—J. B. Shutts is in the market for cement.

Battle Creek, Mich.—Special.—C. Walter Stendell is in the market for all kinds of materials.

Clay Center, Kan.—Special.—Wm. B. Evans, st. comr., advises us that he desires to purchase lumber and cement.

Sorel, Que.—Special.—J. A. Huot, of the R. O. & Nav. Co. workshops, advises us that he is building a swimming bath of concrete, using 2,000 bbls. of cement.

Chicago, Ill.—Special.—J. J. Flanders, room 402, 80 Dearborn st., says he is in the market for crushed stone and cement.

Caldwell, Fla.—Special.—Lem Harding desires to purchase 1,000 bbls. of Portland cement.

Miami, Fla.—Special.—F. Rutter advises that he is in the market for cement, terra cotta pipe, vitrified brick and a centrifugal pump.

Rushville, Ind.—Special.—Clarence Carney advises us that he is in the market for cement.

New London, Conn.—Special.—H. E. Rogers, of the H. E. Rogers Const. Co., advises us that he desires to purchase Portland cement.

Hamilton, Ill.—Special.—Geo. B. Barber advises us that he is in the market for cement.

Greenville, Tex.—Special.—Manco Shepherd desires to purchase brick and cement.

LIGHT, HEAT AND POWER.

New Brunswick, N. J.—The Middlesex Light and Equipment Co. has been incorporated by Louis Wolfrom, William Schlessinger and William Wolfrom.

Newly incorporated electric-light and gas companies:

Swedesboro, N. J. — Swedesboro Gas Light Co.: Wm. S. Connor, Woodbury, N. J.; and John C. Rulon and Wm. H. McCullough, of this city.

Shawnee, O. T. — The Euphony Construction Co. has been incorporated to construct water-works, electric-light and sewer systems. James Rule, of St. Louis, is interested in the company. All of the other incorporators are of this city, and the main offices will be here.

Jersey City, N. J.—Waterfront Contracting and Lighterage Co.: John Sullivan, Wm. S. Rowland and Henry C. Cronan.

Lewiston, Ill.—Fisher Power, Heat and Electric Lighting Co.: Floyd M. Conditt, Theodore Fisher and H. W. Masters.

Bartlett, Tex.—Bartlett Electric Light and Motor Co.: R. S. Decker, W. G. Decker and W. R. Decker.

St. Paul, Minn.—West Side Power, Heat & Light Co.: A. B. Stickney, Oliver Crosby, R. C. Wright.

Hartford, Conn.—Stanislaus Electric Power Co.: John C. Rice, Henry W. Palmer, of Boston; Arthur Perkins, Hartford.

Champagne, Ill.—Edwardsville Light & Power Co.: Charles Zilly, B. E. Bramble, George M. Mattis.

Drain, Ore.—Drain Water, Light & Power Co.: Ira Wimberly, Benton Mires, W. W. Kent, W. C. Edwards, Sam Jones.

Bartlett, Tex.—The Bartlett Electric Light & Motor Co.

Charlotte, N. C.—The Southern Power Co.: Dr. W. Gill Wyle, N. Y. City, prest.; J. B. Duke, N. Y. City, vice-prest.

Cobourg, Ont.—The Borthern-Durham Power Co: W. J. Crossen, John A. Culverwell, C. Donnelly, W. McLean, and a number of others.

MISCELLANEOUS.

Paterson, N. J. — The Cardenas City Water Co. has been incorporated to operate water-works and pumping stations, by Walter Moffat and Louis H. Pink, of New York City, and Wm. Schek, of West Nyack, N. Y.

Indianapolis, Ind.—The Republic Creosoting Co. has been incorporated to make and sell wood preservatives, wood and timber treated therewith, street-paving materials and kindred products. The company will control two branch firms—one in Mobile, Ala., and one in Minneapolis, Minn. The directors of the company are: Peter C. Reilly, James Broden and Ineva T. Reilly.

East Liverpool, O.—The large plant of the American Sewer Pipe Co. was destroyed by fire early in the morning December 21, entailing a loss of $75,000 to $100,000.

Medicine Hat, Alba, Can.—The Great West Sewer Pipe and Tile Co. will establish a plant here. Winnipeg capital is interested.

Patents Concerning Cement and Its Uses.

778,583. Molding Form for Concrete Walls. E. B. Jarvis, Toronto, Can.

778,611. Rotary Cement Kiln. Geo. H. Sharp, Jonesville, Mich.

778,697. Cement Fence Post. Bennett H. McMillan, Wm. C. Johnson and Frank M. Collord, Danville, Ill.

778,868. Jan. 3, 1905. Mold for Making Burial Vaults. Henry Kinney and John M. Pruett, Rockville, Ind.

778,878. Apparatus for Forcing Lime Grout, Cement and the Like. Ernest W. Moir, Westminster, Eng.

778,885. Fireproof Ceiling or the Like. Johannes Nolte, Strassburg, Germany.

778,907. Cement Pipe Mold. Levi Shell, Sibley, Ia.

778,926. Building Construction. Alexander C. Warren, Chicago, Ill.

779,169. Cement Pipe. James H. McDonald, New Haven, Conn.

779,219. Machine for Making Building Blocks. Edward E. Hartwick, Jackson, Mich.

779,288. Apparatus for Forming Concrete Walls. Louis Lane, Toledo, O.

779,318. Fence Post. John Rogers, Platteville, Wis.

779,319. Adjustable Mold for Reinforced Concrete Construction. John C. Russell, Toledo, O.

779,399. Fence Post. Clinton A. Chamberlain, Detroit, Mich.

779,775. Jan. 10, 1904. Plastic Block Machine. Anton Evenstad, Lakota, N. D.

779,795. Method of Concrete Track Construction. Henry B. Nichols, Philadelphia, Pa.

779,880, 779,881. Forming Concrete Piles and Preparatory Piles Therefor. Constantine Shuman, Philadelphia, Pa.

780,098. Jan. 17, 1905. Apparatus for Building Submerged Concrete Works from Above the Surface of the water. Frederick J. Gilman, Montreal, Can.

780,114. Core for Plastic Posts. John F. Martin, Marshall, Mich.

780,167. Molding Apparatus for Artificial Stone. Alfred Gaspary, Markranstaett, near Leipsic, Germany.

780,320, 780,321. Concrete column and Mold Therefor. Samuel B. Burkholder, West Leipsic, O., and Charles G. Geyer, Leipsic, O.

780,357. Fence Post. Wm. F. Kerlin, Rockfield, Ind.

780,566. Jan. 24, 1905. Fireproof Floor and Ceiling. Johannes F. Kleine, Berlin, Germany.

780,638. Fence Post. Andrew and Chas. A. Church, Adrian, Mich.

780,700. Fireproof Building Construction. Joseph Babiczky, Kansas City, Mo.

780,755. Railway Cross Tie. Edward S. Keefer, Cincinnati, O.

780,789. Pipe. Chas. T. B. Gardner, Pittsburg, Pa.

780,823. Manufacture of Concrete Articles. Jacob L. Shough and Robert W. Levitt, Somerset, O.

780,827. Concrete Mixer. Ransom Z. Snell, South Bend, Ind.

780,942. Fence Post. John L. Dillon, Bloomsburg, Pa.

780,950. Rail Tie. Wm. F. Kerlin, Rockfield, Ind.

781,086. Jan. 31, 1905. Reinforced Concrete Structure. Ray C. Newhouse, Columbus, O.

781,105. Wire Fastener for Cement Fence Posts. Adolph M. Snyder, New Carlisle, O.

781,143. Cement Block Machine. Chas. F. Harris and Berkley W. Duck, Indianapolis, Ind.

781,457. Automatic Sand Sifter and Mortar Mixer. Paul B. and August C. Quade, Athens, Wis.

781,514. Mold for Forming Fence Posts, etc. William Gray, Marshall, Mich.

781,611. Molding Flask for Making Fence Posts. Harold A. Low, Lake City, Ia.

12,309. Reissue. Machine for Mixing Concrete or the Like. Wm. J. Judd, New York, N. Y.

781,726, 781,727, 781,728. Feb. 7, 1905. Concrete Mixers. Wm. J. Judd, New York, N. Y.

781,820. Wall Construction. Robert T. Frost, Dows, Ia.

781,844. Building Block. Louis F. McClure, Kansas City, Mo.

781,869. Pavement, Floor, etc., Composed of Plastic Material. James C. Bayles, New York, N. Y.

781,871. Dam and Method of Closing or Completing Same. Wm. L. Church, Boston, Mass., and Nils F. Ambursen, Watertown, N. Y.

782,052. Mixing Machinery. Ernest L. and Arthur W. Ransome, New York, N. Y.

12,314, 12,315. Reissue. Concrete Beam, Girder, etc., with Iron Bars Inlaid for Building Purposes and Manufacture Thereof. Hans Siegwart, Lucerne, Switzerland.

780,827. Concrete Mixer. Ransom Z. Snell, South Bend, Ind.

IMPROVEMENT AND CONTRACTING NEWS

PAVING.

Youngstown, O.—A committee from this city went to Cleveland, December 14, to inspect bitulithic paving constructed by Warren Bros. Co., of Boston.

Minneapolis, Minn.—A Council committee on paving, accompanied by the city engineer and the assistant city engineer, made a short tour of inspection the first part of December, examining the pavements in Milwaukee, Chicago, Canton and Cleveland.

Portsmouth, O.—Suit has been filed in Common Pleas Court by a property owner to restrain the county treasurer from collecting street assessments against property on E. 4th st. The plaintiff also brings a counter-claim against the city for $235.39 as an offset against the street-paving assessments, which aggregate $147.12.

Milwaukee, Wis. — Complaints of poor sidewalk construction received by the Board of Public Works resulted in a decision to enforce a new rule after January 1, requiring all contractors who build sidewalks to file a surety bond guaranteeing the conditions of the walks for two years. If they do not keep the walks in repair for that length of time their licenses will be revoked.

Walla Walla, Wash.—Certain property owners have appealed to the Supreme Court from the decision of Judge Brents

denying an injunction to prevent the collection of taxes levied by the city on the plaintiffs' property on Main and Fourth sts. to pay the Barber Asphalt Paving Company for paving. A petition is being circulated, according to press reports, asking Judge Brents to call a grand jury for the purpose of investigating alleged violations of the law.

CONTEMPLATED WORK.

Akron, O.—Council voted to pave Orleans ave.

Waltham, Mass. — Paving is contemplated for Moody st. Bertram Brewer, cy. engr.

Georgetown, Wash.—Ordinances have been passed for paving several streets.

Santa Fe, N. M.—Council voted to build a number of brick or cement sidewalks.

Kansas City, Mo.—The bd. of pub. wks. has decided to pave 8,000 ft. of 15th st.

Redding, Cal.—The board of trustees has decided to construct cement sidewalks.

Union, Ind.—Contracts will be let in January for constructing 15 mis. of gravel roads.

Roanoke, Va.—This city voted to issue $175,000 improvement bonds for the streets.

Winnebago, Minn.—Council authorized the construction of 251 lin. ft. of cement sidewalk.

Hazleton, Pa.—Ordinances have been passed providing for paving on E. and W. Broad and other streets.

Herkimer, N. Y.—Resolutions have been passed providing for the improvement of a number of roads.

Canton, O.—Considerable paving is contemplated for the near future. F. E. Myers, cy. engr.

Kansas City, Mo.—Bids will be asked soon for macadamizing about 5 mis. of Hickman road. Co. clk.

Baltimore, Md.—A boulevard from the city limits to Roland Park is proposed. H. G. Shirley, roads engr.

Green Bay, Wis.—Council decided, December 15, in favor of asphalt for paving Main and Washington sts.

Valparaiso, Ind. — The contract for building 14 mis. of gravel roads in Union twp. will be let in January.

St. Louis, Mo.—Hearing will be given January 19 on the proposed construction of a large number of sidewalks.

Montgomery, Ala. — Ordinances have been passed providing for the paving of a number of streets. Allen Gilchrist, cy. engr.

Portland, Ore.—A resolution has been passed providing for an appropriation of $26,000 for paving. Chas. Wanzer, cy. engr.

Troy, N. Y.—The Montgomery Board of Supervisors approved, December 8, plans for macadamizing 6 roads, at a cost of about $217,700.

Norfolk, Va.—Council is considering an ordinance providing for the paving of Marshall ave. and appropriating $13,270 for the work.

Olympia, Wash.—The question of paving Main st. is being considered. The estimated cost of the work is $22,000. J. B. Weddell, cy engr.

Dallas, Tex.—Bids will be asked soon for constructing 8 intermediate roads, the bids recently received having been rejected. Co. Engr. Uhl.

San Antonio, Tex.—This city voted to issue $120,000 bonds for the improvement of Alamo plaza, Houston, Soledad and some connecting streets.

Newark, N. J.—Chief Engr. Sherrerd has suggested that bids be received early in January for the brick needed for street paving throughout the next year.

Bay City, Mich. — Resolutions were adopted, December 11, for paving Garfield and Lafayette aves. and Broadway during 1906 with brick, asphalt or bitulithic.

Duluth, Minn.—The city engineer estimates the cost of asphalt paving on 3d st. from 6th ave. W. to 10th ave. E. at $86,892, and with tar macadam at $65,772.

Columbia, Mo.—This city desires information on all kinds of paving materials, prices, etc. Considerable paving is contemplated in the spring. Mayor Stanley Smith.

Columbus, O.—A bill will be introduced in the next Legislature providing for an appropriation of $264,000 for each year of Governor Pattison's administration to secure good roads.

San Francisco, Cal. — The Board of Works has been authorized to expend $8,000 for the improvement of Minna st. from 2d to 3d, and $7,000 to repave Mission st, from Onandaga to the county line.

Brazil, Ind.—Plans for 10 blocks of vitrified brick paving and several miles of cement sidewalks are being prepared and bids will be asked for the work about March 1. Geo. A. Fletcher, cy. engr.

Columbus, O.—This city contemplates grading and curbing 2d ave. from Railroad st. to the north city limits, including the construction of a viaduct of granite or reinforced concrete arch across Cook branch.

Watertown, N. Y. — The Alexandria Bay-Clayton Boulevard Co. was incorporated December 9 for the purpose of constructing and maintaining a boulevard between Clayton and Alexandria Bay, 12 mis. long and following the St. Lawrence river.

Harrisburg, Pa.—Plans are being formulated for paving about 5 mis. of streets next summer. Bids may be asked for any approved paving material, subject to the petition of a majority of the abutting property owners. M. B. Cowden, cy. engr.

Mineola, L. I., N. Y.—The adoption of the constitutional amendment by the voters of this State authorizing an appropriation of $50,000,000 for the improvement of highways has caused the supervisors of Nassau county to take action toward improving certain roads which it was deemed should be improved by resolution adopted February 20, 1903. The estimated cost of improving these roads is $251,700.

White Plains, N. Y.—The fine system of State roads in Westchester county will soon have another important link added, beginning at the village limits of Mount Kisco and running to Pleasantville, thence to Pocantico Hills, where it will connect with the road recently built from this place to North Tarrytown by John D. Rockefeller. The new road will be of macadam, 14 ft. wide and 10 mis. long, and will cost about $78,000.

Terre Haute, Ind. — Plans are being prepared for vitrified brick paving from this city to West Terre Haute, 1½ mis., and the contract will be let in March. Geo. R. Grimes, co. engr.; J. W. Denehie, co. audt.; N. S. Kidder, cv. engr., will have plans ready about March 1 for 70,000 sq. yds. of vitrified brick and creosote paving on 8th st. from Hulman to Maple sts. He will also have plans ready about February 1 for 45,000 sq. yds. of vitrified brick paving on S. 3d st.

Springfield, Ill.—John C. Lanphier, Jr., who recently visited St. Louis, inspected the plant of the Granite Bituminous Paving Co., of that city, and the bitulithic pavement which the company lays. He

says the pavement possesses all the noiseless qualities and resistance of asphalt, and is, in addition, harder, more durable, easier to clean, waterproof and possesses a slightly roughened surface, which largely prevents the slipping and skidding to which vehicles on wet asphalt are so liable.

Springfield, Mo.—The N. Jefferson-st. property owners met recently to discuss street paving. The report of the committee that visited St. Louis recently to inspect bitulithic was read, showing the whole process of preparing and laying this pavement, and stating that the committee was very favorably impressed with the pavement. After a discussion of the whole subject at some length the committee was continued for further investigation and asked to report at a meeting to be held December 12. T. B. Goldsmith, A. Jewell, com.

CONTRACTS TO BE LET.

Grand Rapids, Minn.—Bids are asked until January 6 for constructing a corduroy road. Joseph McMahon, clk.

Vermilion, S. D.—Bids are asked until January 5 for grading during the next year. F. A. Etickson, co. audt.

Brookville, Ind.—Bids are asked until January 2 for constructing a gravel road in Ray twp. Chas. A. Miller, co. audt.

Ottawa, Kan.—Sealed bids are asked until January 3 for constructing sidewalks during 1906. John Halloren, mayor.

Carrcroft, Del.—Bids are asked until January 15 for paving and grading. Armstrong & Joyner, 1133 Broadway, New York, cy. engrs.

Bloomington, Ind.—Bids are asked until January 4 for constructing the Parks Schoolhouse road in Bloomington twp. S. M. Kerr, co. audt.

London, O.—Bids are asked until January 10 for constructing the Drury road in Paint twp. H. L. McCafferty, surv.; John J. Shiffer, co. audt.

Cleveland, O. — Bids are asked until January 10 for completing the North Woodland macadam road. Wm. H. Evers, co. engr.; Julius C. Dorn, co. clk.

Knox, Ind.—Sealed bids are asked until January 13 for grading, macadamizing and paving with gravel certain highways. Lee M. Ransbottom, co. audt.

Jacksonville, Fla.—Bids are asked until January 22 for grading, curbing and paving with vitrified brick about 1,360 sq. yds. Philip Prioleau, cy. engr.

Independence, Mo.—Bids are asked until January 10 for grading Blue and Tarsney roads, and for macadamizing Lee Summit and Greenwood roads. Co. clk.

Wabash, Ind.—Sealed bids are asked until January 9 for constructing a cement sidewalk on Miami st. from Market to Stitt sts. Fremont McLees, cy. clk.

Chattanooga, Tenn. — Sealed bids are asked until January 2 for paving Boyce and Cherry sts. with brick and repaving 7th st. with brick. A. L. Thomas, chmn. B. P. W.

Spencer, Ind.—Sealed bids are asked until January 1 for improving certain highways by straightening, grading and macadamizing. Richard N. Gray, chmn. co. comrs.

Bloomfield, Ind.—Bids are asked until January 2 for building a gravel road in Stockton twp. Co. comrs.

Cleveland, O.—Sealed bids are asked untill January 13 for paving Miles ave., in Warrensville twp. Julius C. Dorn, clk. co. comrs.

Shreveport, La.—Sealed bids are asked until January 9 for paving 6 streets and an alley with asphalt, brick or bitulithic. R. G. Rives, cy. compt.

Helena, Mont.—Bids are asked until January 2 for constructing a good wagon road on the proposed change in the Lewis and Clark Pass county road. Percy R. Witmer, co. clk.

St. Paul, Minn.—Bids are asked until January 2 for paving E. 5th st. with sandstone brick. Also, for grading the alley in block 23, Summit Park addition. John S. Grode, prest. B. P. W.

CONTRACTS AWARDED.

Corydon, Ind.—The contract for constructing a turnpike was awarded to Stobler & Fisher, for $11,397.

Akron, O.—E. McShaffrey & Son secured the contract for paving Lods st. with brick, for $10,665.44.

Oakland, Cal.—The contract for macadamizing Alcatraz ave. was awared to E. B. & A. L. Stone, at 6.4 cents a sq. ft.

Birmingham, Ala.—Special.—A contract for 16,000 sq. yds. of bitulithic paving has been awarded to the Southern Bitulithic Paving Co.

Los Angeles, Cal. — The contract for paving Speedway, from Center st. to Saltair ave. was awarded to the Barber Asphalt Paving Co., of New York City.

Asheville, N. C.—Special.—An additional contract for 5,000 sq. yds. of bitulithic paving on Grove and Phillips sts. has been awarded to Warren Bros. Co., of Boston.

Long Island, N. Y.—The U. S. Wood Preserving Co. submitted the lowest bid, December 12, for paving Union and 3d aves. with wood blocks, at $5,287 and $34,136, respectively.

Oakland, Cal.—Contracts for grading, curbing and macadamizing streets in this city were awarded, December 6, to Blake & Bilger, Michael Murphy and the Ransome Construction Co.

Rensselaer, N. Y.—Bids for improving Riverside ave. with macadam were received, December 15, Martin Murray, of Troy, presenting the lowest bid, at $8,381.50. Action on the bids was deferred.

Toledo, O.—Garrigan Bros. secured the contract for paving Oswald st. and E. Broadway with brick, at $1.16 a sq. yd. The contract for paving Navarre ave. with brick was awarded to Kerlin Bros., at $1.11 a sq. yd.

Niagara Falls, N. Y.—Henry P. Burgard submitted the lowest bid, December 6, for paving Niagara and 19th sts. with asphalt, at $1.75 a sq. yd. for California asphalt, which is 30 cents lower than any other bid submitted.

Shreveport, La.—The contract for paving Line ave., Creswell st. and Herndon ave. with asphalt was awarded, Dec. 12, to the Barber Asphalt Paving Co., at $2.19 a sq. yd. for Herndon ave. and Line st. and $2.28 for Creswell st.

Baton Rouge, La.—Special.—Bids were received November 29 for 54,000 sq. yds. of paving on 18 streets. Bids were received on bitulithic, asphalt and brick. The contract was awarded to the Southern Bitulithic Co., at $2.22 a sq. yd. for foundation and surface, with 5-yr. guaranty.

SEWERS.

CONTEMPLATED WORK.

Willmar, Minn.—Council has ordered the construction of a sewer.

Osceola, Ia.—A new sewerage system with septic tanks is contemplated.

Pentwater, Mich.—Special.—F. F. Wetmore advises us that he is preparing plans and estimates for 3,000 to 5,000 ft. of 12

Centralia, Wash.—A sewerage system will be constructed next spring.

Morris, Minn. — Improvements to the sewerage system are contemplated.

Fayetteville, N. C.—The construction of a sewerage system is contemplated.

Roanoke, Va.—This city voted to issue $100,000 bonds for constructing sewers.

Canton, O.—A large storm sewer will be constructed soon. F. E. Myers, cy. engr.

Altoona, Pa.—A number of new sewers will be constructed. Harvey Linton, cy. engr.

San Jose, Cal.—This city voted to issue $355,000 for building new sewers and schools.

Ocean Park, Cal.—This city voted to issue bonds for extending the sewerage system.

Lincoln, Cal.—This city will vote on the issue of bonds for constructing a sewerage system.

Weatherford, Tex.—This city voted to issue $25,000 bonds for constructing a sewerage system.

Hinsdale, Ill.—Plans and specifications are being prepared for a gravity sewer system for this city.

Bridgeport, Pa.—This city will probably vote next spring on the issue of bonds for a sewerage system.

Grand Rapids, Mich.—Bids will probably be asked in February for constructing the Soldiers' Home sewer.

Tulsa, I. T.—A sewerage system is to be constructed at a cost of $46,000. D. B. Merry and J. G. Patton, engrs.

Klamath Falls, Ore.—Council is discussing the question of issuing bonds for the construction of a sewerage system.

Wilmette, Ill.—Plans and specifications will be prepared for a gravity relief sewer system for this place.

Cloverdale, Cal.—This city voted to issue bonds for the construction of a sewerage system. T. B. Wilson, town clk.

Colorado Springs, Col. — Sewer extension, at a cost of about $14,000, is contemplated. R. H. Ashworth, cy. engr.

Alliance, Neb.—Bids will probably be asked next spring for constructing a sewerage system. D. Waters, cy. clk.

Watertown, S. D.—Council contemplates the construction of a main sewer outlet from Rice st. to the Sioux river.

Oelwein, Ia.—Bids will be asked soon for ½ mi. of tile sewer on Fredericks and Charles sts. Wm. A. Reed, mayor.

Petersburg, Va.—The construction of a sewerage system, at a cost of $30,000, is contemplated. Robt. Budd, cy. engr.

Ravenna, O.—Bids will be asked in February for constructing a sewerage system, including septic tanks and sand filters.

Seattle, Wash.—Ordinances have been passed providing for sewer construction at a cost of $31,000. R. H. Thomson, cy. engr.

Portland, Ore.—Council has passed ordinances providing for the construction of vitrified pipe sewers. Chas. Wanzer, cy. engr.

St. Louis, Mo.—A bill has been passed appropriating $15,000 for the construction of the Gimlin road, east of Broadway, to Baden.

Clinton, Ind.—Mayor Johnson and the City Council are advocating the construction of a sewerage system, at an estimated cost of $75,000.

Ashtabula, O.—City Council voted to issue $3,600 bonds for constructing a main sewer from Sherman to South sts. F. W. Wagner, cy. clk.

Nevada, Ia.—The question of constructing the Skunk river drainage system, which extends from this county into Polk, is being agitated.

Dayton, O.—The estimated cost of storm water sewers for draining the southeastern part of this city is $168,000.

Great Falls, Mont.—Council contemplates constructing an alley sewer between 1st and 2d aves. S., from 9th to 14th sts., at a cost of $6,650.

Storm Lake, Ia.—Special.—Plans for a complete sewerage system for this city will be prepared by the Iowa Engineering Co., of Clinton, Ia.

and 18-in. sewers for this village, and desires prices on round and egg-shaped sewer pipe, manhole covers, traps, trench jacks or braces, etc.

CONTRACTS TO BE LET.

Boone, Ia.—Bids are asked until January 10 for constructing drains. Archie Patterson, co. audt.

St. Johns, Ore.—Bids are asked until Feb. 1 for constructing a sewerage system. W. W. Goodrich, cy. engr.

Cleveland, O. — Bids are asked until January 13 for constructing the Dover ditches. Wm. H. Evers, co. surv.

Long Prairie, Minn.—Bids are asked until January 11 for constructing ditch No. 8. Walter Peltier, co. audt.

Spirit Lake, Ia.—Bids are asked unt'l January 2 for constructing drainage ditch No. 4. C. C. Hamilton, co. audt.

Niles, O.—Bids are asked until January 1 for constructing an 18-in. tile sewer in Vienna ave. Wm. Wilson, cy. engr.

Salt Lake City, Utah.—Bids are asked until January 9 for constructing a storm sewer on 9th South st. Geo. W. Riter, cy. engr.

Terre Haute, Ind.—Contracts will be let about January 1 for 3,000 ft. of vitrified pipe sewer on 6th st. N. S. Kidder, cy. engr.

Washington, Ia.—Bids are asked unt'l Jan. 4 for constructing 3,000 ft. of sewers, to be built of brick blocks. John H. Steck, cy. clk.

Washington, D. C.—Bids are asked until Jan. 15 for constructing 9,000 ft. of trunk sewer. H. B. F. McFarland, chmn. Dist. Comrs.

Rock Island, Ill.—Bids are asked unt'l Jan. 25 for constructing a large sewerage system for the southwest side. Wallace Treichler, cy engr.

Cincinnati, O.—Bids are asked until Jan. 9 for constructing sewers and drains in ravine, west of Morrison ave. Geo. F. Holmes, clk. B. P. S.

Girard, Kas.—Bids are asked until Jan. 5 for constructing a main sewer and laterals in Dist. No. 3. Clay H. Burnett, mayor; J. B. Grantham, cy. clk

Manila, P I.—Bids are asked until Jan. 15 for constructing a system of sewers and appurtenances for this city. Bureau of Insular Affairs, War Dept., Washington, D. C.

Chihuahua, Mex.—Bids are asked until Jan. 15 for constructing a system of sewers and hydraulic works. Rodolfo Valles, prest. com. on impvts., at Municipal Palace, Hidalgo del Parral, Chihuahua.

Texarkana, Tex.—Bids are asked until Jan. 15 for constructing a system of pipe sewers in district No. 5, requiring 13,385 ft. 6-in., 2,424 ft. 8- in., 2,252 ft. 10-in., and 4,582 ft. 12-in. pipe. A. W. Stevens, chmn. bd. impvt.

CONTRACTS AWARDED.

Columbia, Miss.—The contract for constructing a sewerage system was awarded to G. T. Hallas & Co.

Roanoke, Va.—Wingate & McGehee secured the contract for constructing a

sewer system in the Crystal Spring section, for $10,000.

Gulfport, Miss.—The contract for constructing section A of the sewerage system was awarded to A. L. Patterson & Co., of Macon, Ga., for $40,000.

Dorchester, Mass.—The D. F. O'Connell Co., of Dorchester, submitted the lowest bid, December 18, for constructing Dorchester Brook sewer, for $30,974.

New Haven, Conn.—The contract for constructing sewers on Sheffield ave., Starr and Mansfield sts. was awarded to J. F. Dwyer & Co., December 9, for $3,172.50.

Des Moines, Ia.—The contract for constructing a sewer in 9th st., from the Raccoon river to Elm st., 2,669 ft., was awarded to James Horrabin & Co., at $1.59 a lin. ft.

Pittsburg, Pa.—The contract for constructing sewers in Asbury place, Elizabeth, Fingel, Jansey, Nantasket and Uvila sts. was awarded, December 13, to M. O'Herron & Co., for $13,184.

Erie, Pa.—The contract for constructing an 18-in. sewer in Commercial, 19th and Brandes sts. was awarded to J. T. Pressley, and for a 12-in. sewer in Pennsylvania ave. to P. Dole.

Akron, O.—Hunt & Wigley secured the contract, December 9, for constructing sewers in Voris and Thornton sts., for $3,826. The contracts for Bowery and Lake st. sewers were awarded to Hallinan Bros., for $3,155.80.

Chicago, Ill.—The contract for constructing the 95th-st. sewer system was awarded to Nash Bros., for $871,997. This is $16,000 above the lowest bid received the first time bids were received by the Board of Local Improvements, the city having lost that amount by readvertising.

WATER WORKS.

Defiance, O.—The Federal Court at Toledo decided, December 12, that this city must pay the water company $50,000 for services rendered. The matter has been in litigation for a long time.

CONTEMPLATED WORK.

Toccoa, Ga.—A water-works system is contemplated.

Battle Lake, Minn. — A water-works system is proposed.

Granville, N. D.—Estimates are being made for a water-works system.

St. Cloud, Minn.—The improvement of the water supply is contemplated.

Chatham, Va.—This city voted to issue bonds for increasing the water supply.

Hanford, Cal.—About $15,000 will be expended in improving the water-works system.

Frankfort, Ind.—Bids will be asked for installing a new municipal water-works system.

Carrollton, O.—The question of obtaining an increased water supply is being considered.

Monett, Mo.—This city voted to issue $5,000 for improving the water-works system. Mayor.

Rosalin, Wash.—This town voted to construct new water works. W. W. Pickett, town treas.

Murray, Utah. — The construction of water works here is contemplated at a cost of about $15,000.

Pittsfield, Mass.—Some surveys have been made to determine possible sources of additional supply.

Rainy River, Ont.—The proposed water-works system will cost about $33,000. F. A. Gormley, town clk.

Gallup, N. M.—This town will issue $10,000 bonds for a water-works system. F. W. Meyers, town clk.

Roslyn, Wash.—The question of constructing a water-works system may be taken up soon. W. P. Morgan, mayor.

Waitsburg, Wash.—Council has decided to install a gravity filtration plant, according to press reports.

La Junta, Col.—Surveys and plans are being made for a pumping station for the water works. S. W. Brown, cy. clk.

Oakman, Ala.—The construction of a reservoir or tank, piping the town and installing fire plugs is contemplated.

Troupsburg, N. Y.—A company of business men has been formed and a water-works system will be constructed next spring.

Ogden, Utah.—The question of granting a water franchise to the Ogden Water Works Co. is under discussion. Mayor Glassman.

Joliet, Ill.—A new 6,000,000-gal. pumping engine has been recommended for the water works. John Beckwith, supt. w. w.

Milwaukee, Wis.—City Engr. Poetsch has recommended the installation of a 20,000,000-gal. pump for the water works.

Negaunee, Mich.—This city is considering the purchase and installation of 1,000 water meters. Edw. Anthony, prest. B. P. W.

Rockford, Ill.—D. W. Mead, cons. engr., recommends the purchase of some new equipment for the water-works system. Wm. Johnson, chmn. w. w. com.

Hattiesburg, Miss.—City Council passed an ordinance providing for the issue of $35,000 bonds for improving and extending the water supply.

St. Charles, Ill.—The estimated cost of the proposed new water-works system is about $50,000. No bids have yet been received. F. E. Glenn, mayor.

Pratt City, Ala.—Special.—E. J. Hudnall desires to purchase an air compressor and water meters. The city also wants funds to enlarge the plant.

Glasgow, Mont.—Special.—A. W. Mahon, cy. engr., advises us that material, machinery and tools may be purchased for water-works and electric-light construction.

Manitowoc, Wis.—Plans and estimates for a new municipal water-works system are being made by F. W. Cappelen, of Minneapolis, assisted by Cy. Engr. Unger.

Seattle, Wash. — Plans and specifications will be prepared by City Engineer Scott for a new 1,000,000-gal. standpipe to be erected for the water department in Volunteer Park.

Malone, N. Y.—This city voted to purchase the water-works system, offering to pay $200,000 for the plant, and if the company refuses a new plant will be constructed.

Montclair, N. J.—A committee of 10 has been appointed to investigate the advisability of purchasing the present plant or constructing new municipal works. D. D. Duncan, mayor.

St. Cloud, Minn.—Special.—J. E. Hill, cy. engr., advises us that this city desires to purchase centrifugal pumps, 16-in. c. i. pipe or spiral pipe, flange pipe and a pump.

Hobart, O. T.—Bids are asked until January 9 for drawing plans and specifications for the extension of 4 mis. of 6-in. water mains and the erection of a water tower. A. W. Kerr, cy. clk.

Newport, Ky. — The extension of the water-works system of this city to include the towns of Southgate and Clifton is contemplated. This will necessitate the erection of a pump and tank.

Santa Monica, Cal.—The city engineer's plans and estimates for a municipal water-works system have been accepted by the

Board of Trustees, and the question of issuing bonds will be voted on soon.

Dallas, Tex.—The estimated cost of installing a large service pump at the Turtle Creek pumping station and a building to house all the machinery is about $204,000. J. M. Bassett, ch. engr. w. w.

Sault Ste. Marie, Mich.—A special committee of Common Council reported in favor of the adoption of a meter system, and bids will be asked at once for supplying meters for the entire city. Cy. clk.

Berthoud, Col. — Engr. Anderson has recommended to Town Council, according to press reports, the construction of a sand filter, and that the surface of the lake be raised 2 ft. for a greater pressure.

Duluth, Minn.—The question of issuing $200,000 of water and light bonds for building the "hill" system of water works, a new pumping engine at Lakewood, a gas holder, etc., will be voted on February 6.

Walla Walla, Wash.—This city has decided to formulate plans for the construction of a supplementary water system that will insure an adequate supply of pure and wholesome water. The question of issuing bonds will be voted upon during January.

Brockton, Mass.—The report of Chas. R. Felton, cy. engr., recommends increasing the water pressure 30 lbs. for fire purposes. If adopted it will entail the construction of a new standpipe, about 6,000 ft. of 30-in. main and changes in the pumps.

Ballard, Wash.—Mayor Zook has authorized the street committee to take up the question of securing Cedar river water from Seattle, and if no satisfactory arrangement can be made Council will take steps toward securing an independent supply and may install a municipal system.

Kingston, N. Y.—The State Water Supply Commission, after taking testimony in support of New York City's application to secure additional water supply in the Catskills, ended December 19, and the commission adjourned until January 10, when it will meet in New York City to hear the city of Yonkers in opposition to the proposed line of aqueduct.

Orange, N. J.—Rudolph Hering, cons. engr. of New York City, who was engaged to pass upon the plans for improving the water system, has recommended an entire new scheme in his report. He condemns the proposed open reservoir, and says that it should be stored in a covered reservoir and thereby protected from bacteria and unwholesome influences. He recommends the installation of a filtration plant and pumping the water from Campbell's pond, after it has been filtered. He estimates the cost of this work, together with some other improvements to the system, at $250,000.

CONTRACTS TO BE LET.

Fostoria, O.—Bids will be asked about February 1 for a filtration plant of concrete. B. P. S.

Osceola, Ark.—Sealed bids are asked until January 10 for constructing a waterworks system. Bd. of Impvts.

Lincoln, Neb. — Bids are asked until January 15 for a complete high-duty pumping engine. T. H. Pratt, cy. clk.

Brazil, Ind.—Bids will be asked about March 1 for a concrete gallery or reservoir. Geo. A. Fletcher, cy. engr.

Argenta, Ark. — Bids are asked until January 15 for constructing a water works and electric-light system. Bd. of Impvts.

Piedmont, W. Va.—Bids are asked until January 2 for constructing a gravity water-works system. H. B. Carroll, prest. Piedmont W. W. Co.

Albany, N. Y.—Bids are asked until January 15 for pumping engines at the Quackenbush pumping station. Isadore Wachsman, clk. bd. cont. & sup.

Manila, P. I.—Sealed bids are asked until January 2 for constructing a gravity until January 5 for lighting with naphtha water supply for this city. Chief Bureau of Insular Affairs, Washington, D. C.

Key West, Fla.—Bids are asked until January 15 for constructing one 104,000-gal. concrete cistern, two 14,000-gal. concrete cisterns, and enlarging a cistern now in use. Q. M.

St. Paul, Minn.—Sealed bids are asked until January 11 for constructing an 8-in. water main from 9th and Rosser sts., Bismarck, to Fort Lincoln, N. D. J. E. Sawyer, C. Q. M.

Macon, Miss.—Bids are asked until January 9 for erecting a tank and tower, a filter plant, a clear-water basin and a raw-water basin. J. O. Faser, mayor; T. J. Mayers, town clk.

Mitchell, S. D.—Bids are asked until January 1 for a 2,000,000-gal. and a 1,500,000-gal. horizontal cross compound condensing Corliss crank and fly-wheel pumping engine. J. G. Markham, cy. audt.

Chihuahua, Mex. — Sealed bids are asked until January 15 for constructing a water-supply system for this city. Rodolfo Valles, prest. com. on impvts., Municipal Palace, Hidalgo del Parral, Chihuahua.

Hobart, O. T.—Bids are asked until January 9 for drawing plans and specifications for the extension of about 4 mis. of 6-in. water mains and the erection of a water tower in connection with the water system. A. V. Kerr, cy. clk.

St. Louis, Mo.—Bids are asked until January 19 for furnishing 6,500 tons of 6, 12 and 20-in. c. i. coated water pipe, 250 tons of c. i. coated special castings, 180 tons of 6, 12, 20 and 36-in. stop valves and 275 fire plugs. W. B. Dryden, sec. B. P. I.

CONTRACTS AWARDED.

Fort Screven, Ga.—The contract for a pump house and machinery for this place was awarded to Hurley & Co., of St. Paul, Minn.

Seattle, Wash.—The contract for laying water mains in E. Prospect st. was awarded to the Intnernational Contract Co., for $21,029.

Denver, Col.—The contract for a new pumping plant at the City Park was awarded to J. George Leynor Co., for $16,693.

Martinsburg, W. Va.—The contract for a new pump for the water-works pumping station was awarded to the Holly Mfg. Co., for $5,600.

Chicago, Ill.—The contract for furnishing 1,152 meters was awarded, December 6, to the Henry R. Worthington Co. and the Neptune Meter Co., for $27,000.

Casey, Ill.—A 30-yr. water-works franchise was granted to W. F. Jamison and W. E. Strather, December 21. The city agrees to use 35 street hydrants at an annual cost of $50 each.

Wilmington, N. C.—The Clarendon W. W. Co. has awarded the contract for installing a mechanical filtration plant to the Pittsburg Filtration Co., of Pittsburg, Pa., for $25,000.

Hammond, La.—The contracts for constructing the water-works and drainage systems was awarded, December 15, as follows: Construction, Roy Stookey, of Belleville, Ill.; pipe, U. S. Cast Iron Pipe and Foundry Co., of Pittsburg; hydrants and valves, Herron Pump and Foundry Co., of Chattanooga, Tenn.:

tower and tank, Des Moines Bridge and Iron Works, Des Moines; artesian wells, Ed C. Way, of Hammond.

BRIDGES.

Port Huron, Mich.—A bridge is contemplated at Military st., according to press reports.

La Crosse, Wis.—The La Crosse City Ry. Co. will erect a bridge over La Crosse river here.

Oberlin, Kan.—Bids are asked until January 3 for constructing steel bridges. L. F. Campbell, co. clk.

Lyndon, Kan.—Bids are asked until January 2 for building steel bridges. John W. Yeomans, co. clk.

Haverhill, Mass.—Plans and specifications have been prepared for the proposed bridge across the Merrimac river.

Richmond, Va.—City councils of this city and Manchester have united in the new bridge project to cross the James river.

Cheyenne, O. T.—Bids are asked until January 3 for building an iron bridge across the Washita river. John H. Osberne, co. clk.

Pembina, N. D.—Bids are asked until January 15 for constructing a steel bridge across Pembina river. Swain Thorwaldson, co. audt.

Fort Wright, Wash.—A bill has been introduced appropriating $100,000 for a bridge across the Spokane river near here.

Huron, S. D.—Bids are asked until January 10 for constructing all bridges required for the ensuing year. L. C. Burney, co. audt.

Pensacola, Fla.—Bids are asked until January 1 for building a steel bridge across Perdido river. A. M. McMillan, co. clk.

Vermillion, S. D.—Bids are asked until January 5 for constructing all bridges in Clay co. during 1906. F. A. Erickson, co. audt.

Barberton, O.—Plans have been adopted and bids are asked until January 8 for building a new bridge over Mud Run. Co. comrs., Akron.

Chattanooga, Tenn.—Bids are asked until January 9 for building the superstructure of a steel highway bridge. A. L. Thomas, chmn. B. P. W.

Duluth, Minn.—Sealed bids are asked until January 2 for building a steel bridge across St. Louis river, near Zim. O. Holden, co. audt.

Youngstown, O.—Bids are asked until January 1 for constructing a viaduct over Erie R. R. from Wood to Federal st. F. M. Lillie, cy. engr.

Cleveland, O.—A resolution has been adopted directing the city engineer to prepare plans for a high-level bridge connecting Huron and Lorain sts.

Blue Earth, Minn.—Bids are asked until January 3 for building a steel bridge on steel piers across Blue river. Also two smaller steel bridges. G. B. Franklin, co. audt.

Pittsburg, Pa.—Bids are asked until January 3 for building a draw bridge across the back channel of the Ohio river at Bruno Island, Pittsburg Harbor. E. H. Ruffner, Lt.-Col. Engrs.

New York City.—A resolution has been aprpoved providing for the issue of $115,000 corporate stock for constructing a bridge over Mosholu Parkway drive and approaches thereto in Bronx boro. Bd. of est. and appor.

Salem, Mass.—Bids are asked until Jan. 4 for constructing the substructure and superstructure of a rolling lift bridge over the New Canal on Western ave., Gloucester, Mass. Bids are asked until January 4 for building a new bridge over the Danvers river, between this city and Beverly. Essex co. comrs.

STREET LIGHTING.

Gadsden, Ala.—A municipal gas plant is proposed.

Elkader, Ia.—Special.—This city voted, December 20, to erect a gas plant.

Ackley, Ia.—A new municipal lighting plant will soon be installed.

Belleville, Kan.—The citizens have decided to install a light plant.

Aurora, Neb.—This town is planning to install a municipal lighting plant.

Duluth, Minn.—The question of issuing bonds for a new gas holder will be voted on February 6.

Anaheim, Cal.—Bids are asked until January 9 for a gas pipe line franchise. Edward Merritt, cy. clk.

Dothan, Ala.—Bids are asked until January 1 for a franchise for a gas plant. R. W. Lisenby, town clk.

Creighton, Neb.—The citizens have organized a stock company for installing an electric-light plant.

Freeport, Ill.—Bids are asked until January 2 for lighting this city for 5 yrs. Wm. Waterstradt, cy. clk.

Shenandoah, Va.—Bids are asked until January 2 for constructing a lighting plant. D. S. Louderbeck, mayor.

Whitehall, N. Y.—The local electric-light company is considering the question of installing a gas plant.

Tallapoosa, Ga.—Bids are asked until January 2 for installing an electric-light plant. G. W. W. Shepperd, mayor.

Woburn, Mass.—The Board of Aldermen is considering an ordinance for establishing a municipal electric-light plant.

Wood River, Neb.—Plans and specifications are being prepared for an electric-light and water-works plant here.

Argenta, Ark.—Bids are asked until January 15 for erecting an electric-lighting plant. J. M. Pearsall, prest. bd. impvt.

Richmond, Ind.—This city contemplates expending $30,000 for increasing the capacity of the municipal power and light plant.

St. Mathews, S. C.—The question of issuing bonds for the construction of an electric-light plant will be voted on soon.

Troy, N. Y.—The estimated cost of erecting a county electric-lighting plant for the various county buildings is $16,136.

Central Falls, R. I.—Council will consider the matter of appropriating $75,000 for installing a municipal lighting plant.

Elbow Lake, Minn.—Bids are asked until January 4 for electric-light fixtures for the new Grant county court house. J. S. Arneson, co. audt.

Glasgow, Mont.—Special.—A. M. Mahon, cy. engr., says material, machinery and tools may be purchased for constructing water works and electric lights.

GARBAGE DISPOSAL, STREET CLEANING AND SPRINKLING.

Sioux City, Ia.—The question of constructing a garbage plant will be considered by the City Council.

Superior, Wis.—Bids will probably be asked in May for collecting city garbage. J. A. Rene, health officer.

Portsmouth, O.—Bids will be received at the first meeting of the B. P. S. in

January for the removal of the city's garbage.

York, Pa.—City Council awarded, December 13, the contract for garbage disposal to Charles C. Fischer, of Reading, at $16,076 a year for 10 yrs.

Council Bluffs, Ia.—Bids will be received about April 2 for a 1-yr. contract for the collection of garbage. Dr. M. A. Tinley, health officer.

Racine, Wis. — Bids are asked until January 13 for constructing and installing a garbage disposal plant, either a crematory or reduction plant. B. P. W.

Rochester, N. Y.—The contract for the collection and disposal of garbage and dead animals for 1906 was awarded to W. A. Hartung, for $535,685.50.

Fort Barrancas, Fla.—Bids are asked until January 8 for constructing a garbage crematory building and installing therein a garbage crematory. Sam R. Jones, C. Q. M.

Detroit, Mich. — Bids for a garbage plant or plants having an aggregate capacity of 200 tons a day were submitted December 11 as follows:

Dixon Garbage Crematory Co., Toledo, O., four 50-ton plants, $80,000.

Detroit Sanitary Works, to sell its plant at French Landing, Mich., increased to 200-ton capacity, including 13 acres of land and seven 2-story workmen's houses, for $100,000.

Lewis & Kitchen, Chicago, Ill., submitted 7 bids from *a* to *g*, as follows: *a*. Storage capacity 50 tons, 1 plant, $26,540; 2 plants, $31,600; cost of cremation, 45 cents per ton. *b*. Sixty tons, 1 plant, $31,860; 2 plants, $59,800 and 40 cents per ton. *c*. 100 tons, 1 plant, $35,650; 2 plants, $68,400 and 30 cents per ton. *d*. 120 tons, 1 plant, $41,080; 2 plants, $77,800 and 30 cents per ton. *e*. 100 tons, $52,590, 45 cents per ton. *f*. 120 tons, $61,680 and 35 cents per ton. *g*. 200 tons, $69,875 and 25 cents per ton.

Several others bids were received, but, it is reported, were not read on account of being irregular.

For the disposal of garbage the Detroit Sanitary Works, of Detroit, bid for 1 yr. $24,600, 3 yrs. $14,600 per yr., 5 yrs. $13,600 per yr. and 10 yrs. $12,000 per yr. The Detroit Reduction Co., of Detroit, 10-yr. contract, no compensation. If this proposal is accepted the company agrees, if desired, to dispose of all household and shop waste, office and street sweepings and ashes, and all other rubbish, at 25 cents per ton; and if ashes are kept separate from above, for 20 cents per ton. Disposal of night soil, 25 cents per bbl. The company agrees to sell its plant to the city at an appraised valuation at any time prior to the termination of the contract.

FIRE APPARATUS.

Kokomo, Ind.—City Council has decided to construct a new fire-alarm system.

San Jose, Cal.—This city voted to issue bonds for a new fire engine and apparatus.

Aurora, Ill.—The purchase of a combination chemical and hose wagon is contemplated. Mayor Douglas.

Nashville, Tenn.—The budget contains an appropriation of $1,800 for the purchase of a combination wagon. Chief Rozetta.

Glasgow, Mont.—This city is in the market for cotton hose, a hose cart, nozzles, coats, hats, axes and a chemical outfit. A. W. Mahon, cy. engr.

Rock Island, Ill.—Bids are asked until January 1 for a hook and ladder truck and a wagon for the fire department. Bids will be asked about February 1 for a fire-alarm system. A. C. Schaffer, cy. clk.; Wallace Treichler, cy. engr.

TOO LATE FOR CLASSIFICATION

Little Rock, Ark.—This city contemplates the construction of two storm water sewers.

Preston, Ont.—This city approves the proposed establishment of sewerage and water works systems.

Lockhart, Tex.—This city will vote, Jan. 16, on the question of issuing $5,000 bonds for street improvements.

Lynchburg, Va.—This city is considering the question of paving several streets with Medina sandstone blocks.

Santa Ana, Cal.—The City trustees have decided to establish a sewer farm to utilize the water from the outfall sewer.

Monticello, Ill.—The bd. of local impvts. has decided on the construction of 34 blocks of paving, the work to begin next spring.

Monmouth, Ill.—City council decided, Dec. 18, to give the w. w. committee power to act in making a contract for an air lift machine for the water works system.

Belvidere, Ill.—A petition is being circulated asking that E. Lincoln ave. be paved with macadam. The question of macadamizing W. Lincoln ave. is also being agitated.

Kalamazoo, Mich.—Special.—M. C. Taft says contracts were awarded, December 19, as follows: Rose st., 10,000 sq. yds. with asphalt, Barber Paving Co.; Edwards st. and Michigan ave., 15,000 sq. yds., Metropolitan block with "Pioneer" filler.

Peru, Ind.—Common council has granted a petition of the Oakdale Company to extend the Benton st. sewer along the Chili pike to the belt railroad, which is the northern limit of Oakdale.

Marion, O.—The property owners on Franklin st., from Vine to Bradford, have petitioned for asphalt paving. An ordinance has been adopted authorizing the purchase of 11.59 acres of land for public park purposes.

Newark, N. J.—Bids are asked until January 16 for furnishing and installing bronze lamps and gas fixtures for the new city hall building and boiler house. Jas. E. Howell, chmn. com'n., 800 Broad st.

Milwaukee, Wis.—Sealed bids are asked or other illuminant the parks and parkways under the control of the park commissioners for 3 or 5 yrs. Daniel Erdman, chmn. park comrs.

Dunkirk, N. Y.—Common council voted, Dec. 20, to build new sewers in Canary and W. Front sts.

Lockport, N. Y.—This city voted, Dec. 20, in favor of municipal ownership of a water works system.

Covington, Ky.—Creosote block paving is favored for Madison ave., between 4th and 11th sts. Cy. Engr. Gunn.

Arlington, S. D.—This city voted to issue bonds for constructing a water works system.

Pueblo, Colo.—Hiram Phillips, of St. Louis, has been appointed assistant engineer for the proposed paving.

Muscatine, Ia.—Paving is proposed for a large number of streets next year, although no definite action has been taken on the proposed work.

Buffalo, N. Y.—Bids for repaving Mariner st., from North to Allen, were submitted Dec. 22, the lowest bid being submitted by the German Rock Co., at $2,645.

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